# Current Science, Vol. XVII, 1948

## Author Index

# Subject Index

Editor: M. Sreenivasaya, B.A., F.I.I.Sc., F.A.Sc.
206-49 Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore.

[redacted]

Current Science

Vol. XVII] JANUARY 1948 [No. 1



# THE EIGENVIBRATIONS OF CRYSTAL STRUCTURES*

## 1. INTRODUCTION

AS is well known, the atomic architecture of a crystal may be described as a three-dimensionally periodic distribution of matter in space on a very fine scale. The regularity of such arrangement is, however, liable to be disturbed in various ways and especially by the thermal agitation in the crystal or by the incidence of radiations on it, and the atoms then vibrate about their respective positions of equilibrium. A knowledge of the modes and frequencies of the vibrations thus arising is of the greatest possible importance for the theory of the solid state. For, it enables us to evaluate the strength of the interatomic forces and thus to obtain a quantitative physical picture of the structure of the crystal, supplementing the geometric description furnished by X-ray analysis. Further, such knowledge is the basis for a development of the theory of the physical properties of crystals, including especially all those which depend on or are influenced by the temperature of observation.

The volume of papers under review is intended to furnish a definitive answer to the problem of ascertaining the modes and frequencies of vibration of the atoms in a crystal in relation to their geometric distribution in space and the forces holding them together as a rigid structure. Of the 19 papers forming the symposium, 9 describe new experimental results obtained from investigations specially designed to throw light on this fundamental problem. These experimental papers are richly illustrated, no fewer than 65 separate spectrograms

* *Symposium of Papers on the Vibration Spectra of Crystals*, December 1947, 190 pp. with 18 plates. Published by the Indian Academy of Sciences, Bangalore.

and 35 microphotometer records besides numerous diagrams being reproduced to aid the reader's understanding and appreciation of the results of the researches. The introductory paper of the symposium furnishes the necessary theoretical background, while the remaining nine papers are devoted to the consideration of the consequences of the theory in particular cases and their comparison with the facts of experiment. Before entering into a discussion of the theoretical aspects of the subject, it appears desirable to present the reader with a review of the experimental situation as it emerges from the symposium.

## 2. The Scattering of Light in Crystals

Many investigations on the vibration spectra of crystals have been made during the past twenty years by the method first employed in 1928 by the present writer, *viz.*, illuminating the crystal by monochromatic light and recording the spectrum of the scattered radiations emerging from it. While much empirical knowledge of value has accumulated as the result of such studies, they left untouched the fundamental problem of ascertaining what the *complete* vibration spectrum of any crystal is and of how it is related to the structure of the crystal. Investigations designed to resolve this problem were undertaken at Bangalore a few years ago by Dr. R. S. Krishnan. Numerous crystals have been studied with the utmost possible thoroughness and a rich harvest of results obtained in every one of the cases investigated, *viz.*, calcite, quartz, barytes, gypsum, fluorspar, corundum, topaz, diamond, rock-salt, sylvine, ammonium chloride, ammonium bromide. We shall presently proceed to take note of such of these studies as are now reported on. As an example of the results which previously found publication, we may mention the case of calcite, with which no fewer than 16 frequency shifts were recorded by R. S. Krishnan as against a maximum of 7 by earlier workers. The following facts observed with this crystal may be regarded as typical of those noticed with inorganic crystals generally. (*a*) The frequency shifts recorded with small or moderate exposures represent the *first-order* spectrum, namely, the fundamental eigenfrequencies of atomic vibration in the crystal which are active in light scattering. (*b*) In strongly exposed spectograms, frequency shifts are recorded with appreciable intensity which represent the vibration-spectra of higher orders, *viz.*, the overtones and summationals of the eigenfrequencies, including those not recorded as fundamentals. (*c*) The frequency shifts of all orders are recorded as sharply defined lines on a clear field, the apparent spectral width of such lines in many cases being no greater than that of the mercury arc lines registered on the plates with comparable intensities. (*d*) When the crystal is heated, the spectral lines broaden and shift towards the position of the exciting radiation and their peak intensities diminish notably. (*e*) *Vice-versa*, if the crystal is cooled to liquid-air temperature, the spectral lines sharpen and shift away from the exciting radiations while their peak intensities increase. But these effects are by no means so conspicuous as those of the opposite kind noticed on heating (see Figs. 1, 2 and 3).

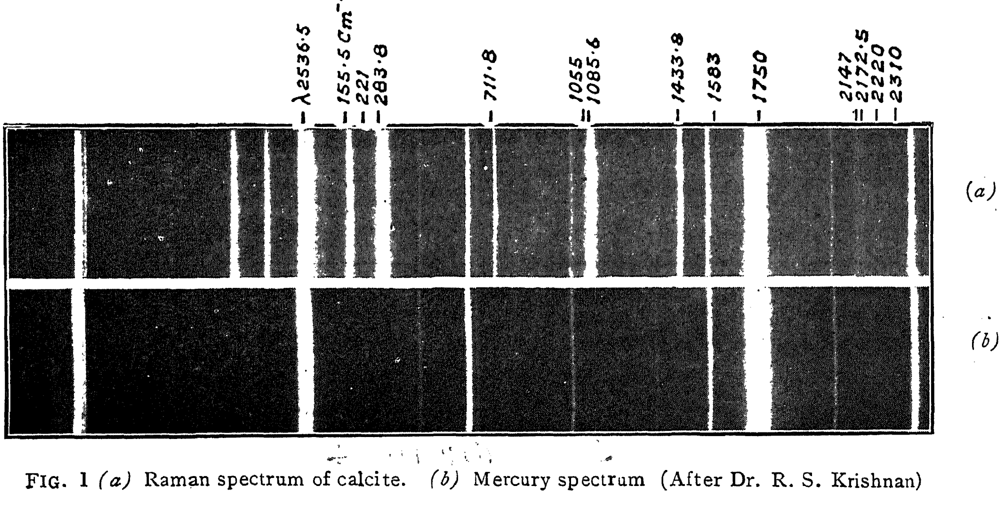



FIG. 1 (*a*) Raman spectrum of calcite. (*b*) Mercury spectrum (After Dr. R. S. Krishnan)

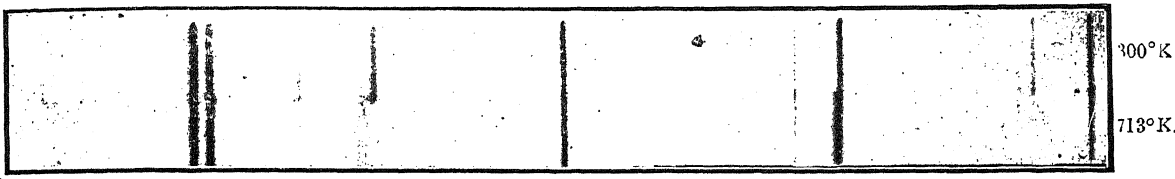



FIG. 2. Variation with temperature of the Raman spectrum of calcite (After P. K. Narayanaswamy)

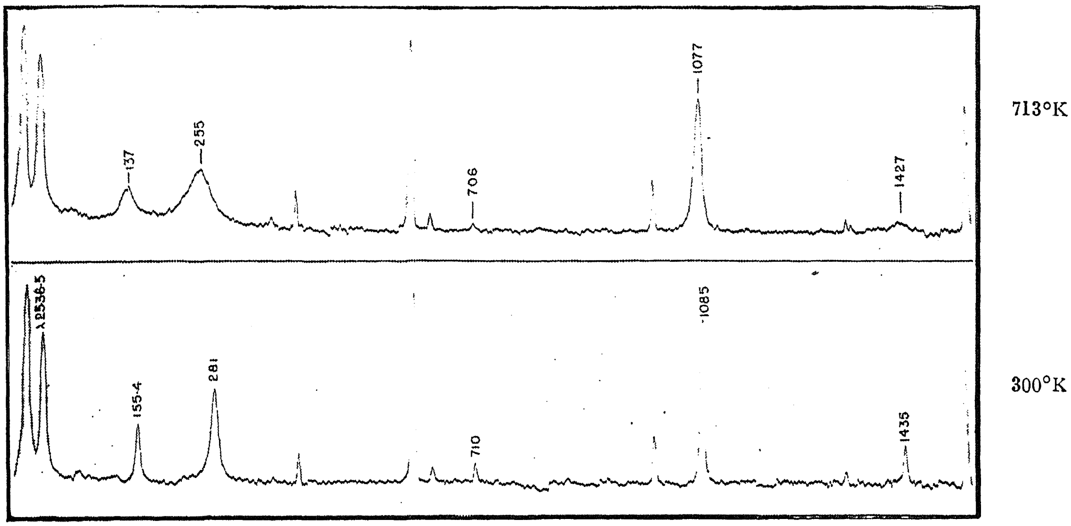



FIG. 3. Microphotometer records of the Raman spectrum of calcite at two different temperatures (After P. K. Narayanaswamy)

### 3. The Cases of Corundum and Topaz

These are two well-known crystals found in nature, while the former can also be prepared synthetically. Corundum is of much simpler composition and structure than topaz, and is a crystal of the trigonal class, while topaz is orthorhombic. These differences are reflected in the degree of complexity of their vibration spectra, 7 frequency shifts being recorded by Dr. R. S. Krishnan with corundum and 32 with topaz, as compared with a maximum of 2 and 11 frequency shifts respectively reported by earlier authors. The lower crystal symmetry of topaz evidently results in a much larger proportion of the possible modes of vibration being active in light-scattering than in the case of corundum. Fig. 4 reproduces, in part, the spectrogram of pure topaz obtained in light-scattering, while Fig. 5 is the *luminescence* spectrum of topaz containing a trace of chromic oxide as impurity recorded with the crystal held at liquid-air temperature. A comparison of the frequency shifts from $\lambda$ 2536·5 as observed in light-scattering and from $\lambda$ 6824·9 (the principal chromium line) as observed in luminescence shows a most remarkable concordance. The bands observed in the luminescence spectrum of ruby and also those observed in its absorption spectrum are successfully explained on similar lines in terms of the vibration frequencies of the corundum crystal observed in light-scattering and in infra-red absorption.

It is obvious that the mechanism of the diffusion of light by a crystal and the mechanism of its impurity-activated luminescence are very far from being identical. That nevertheless there is a concordance between the vibration-spectra as observed by the two methods is theoretically significant. It indicates that the vibration spectrum of a crystal as observed in light-scattering is not fundamentally different in its general character from the *complete* vibration-spectrum. In other words, the latter is essentially a *line-spectrum* exhibiting a discrete set of frequencies. This conclusion is reinforced by a vast array of other

evidence furnished by critical studies of the spectroscopic behaviour of numerous crystals by diverse methods reported in the literature during the last twenty years. It will not, however, be necessary for us to enter into a description or discussion of such evidence, since the facts regarding magnesium oxide discussed in *Current Science* for December 1947, and those regarding diamond and the alkali halides which we shall presently consider completely clinch the issue.

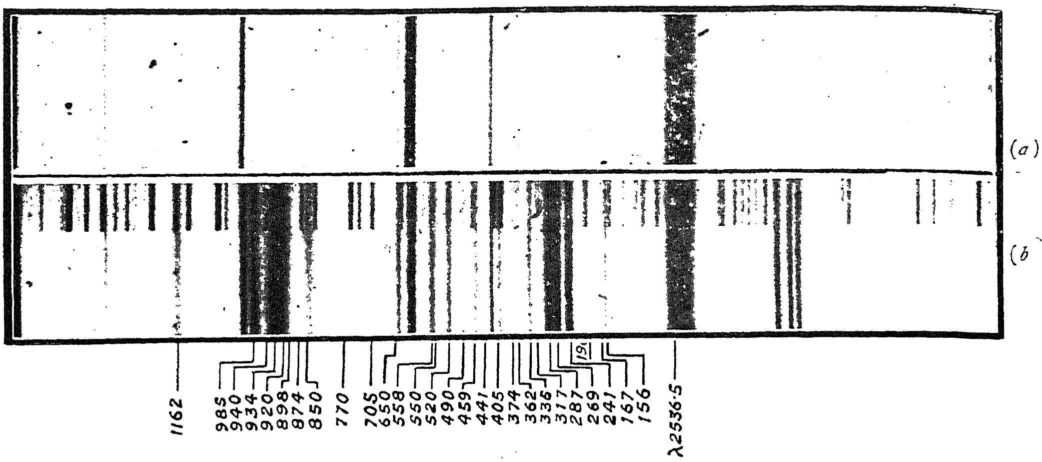



FIG. 4. *(a)* Mercury spectrum. *(b)* Raman spectrum of topaz (in part) (After Dr. R. S. Krishnan)

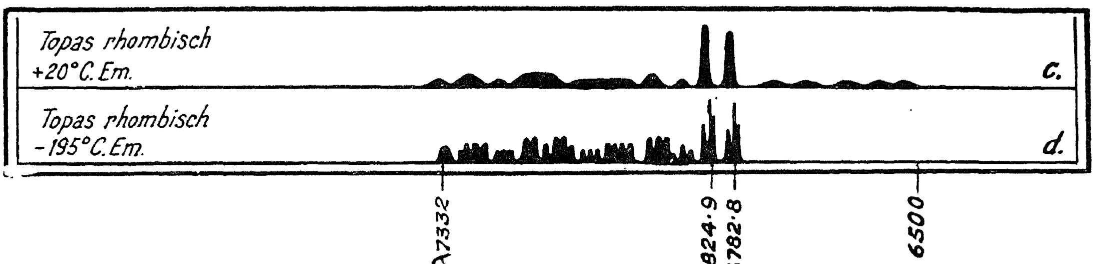



FIG. 5. Luminescence spectrum of topaz (After Deutschbein)

## 4. The Case of Diamond

Five of the papers in the symposium deal exclusively with the spectroscopic behaviour of diamond, and we may here briefly summarise their contents. Dr. R. S. Krishnan reports, in continuation of his earlier studies, a thorough investigation on the scattering of light in diamond, examined spectroscopically. The frequency shifts observed are of three kinds as indicated against them in Fig. 6; the Brillouin shifts in the vicinity of the exciting radiation $\lambda$ 2536·5 are less intense than the first-order frequency shift of 1332 cm.$^{-1}$, but both are recorded with short exposures, while the second-order spectrum requires much heavier exposures. Under the high resolution provided by the Hilger $E_1$ quartz spectrograph, the Brillouin components due to the longitudinal and transverse sound-waves which reflect the light waves are successfully resolved from each other (Fig. 7), the transverse sound-waves for some unexplained reason giving the more intense components. The sound velocities of both kinds determined from the frequency shifts are found to vary with the direction of their travel [*vide* Figs. 7 (*a*), (*b*) and (*c*)] is to be expected theoretically. Their numerical values for the different directions agree fairly well with those determined by Bhagavantam and Bhimasenachar by the ultrasonic method. The same high-resolution spectrograph also suffices to resolve the spectrum recorded in the region of frequency shifts between 2665·4 cm.$^{-1}$ and 2015 cm.$^{-1}$ into discrete lines. The shift 2665·4 cm.$^{-1}$ which stands out very clearly in the spectrum as a distinct line is clearly the octave of 1332 cm.$^{-1}$

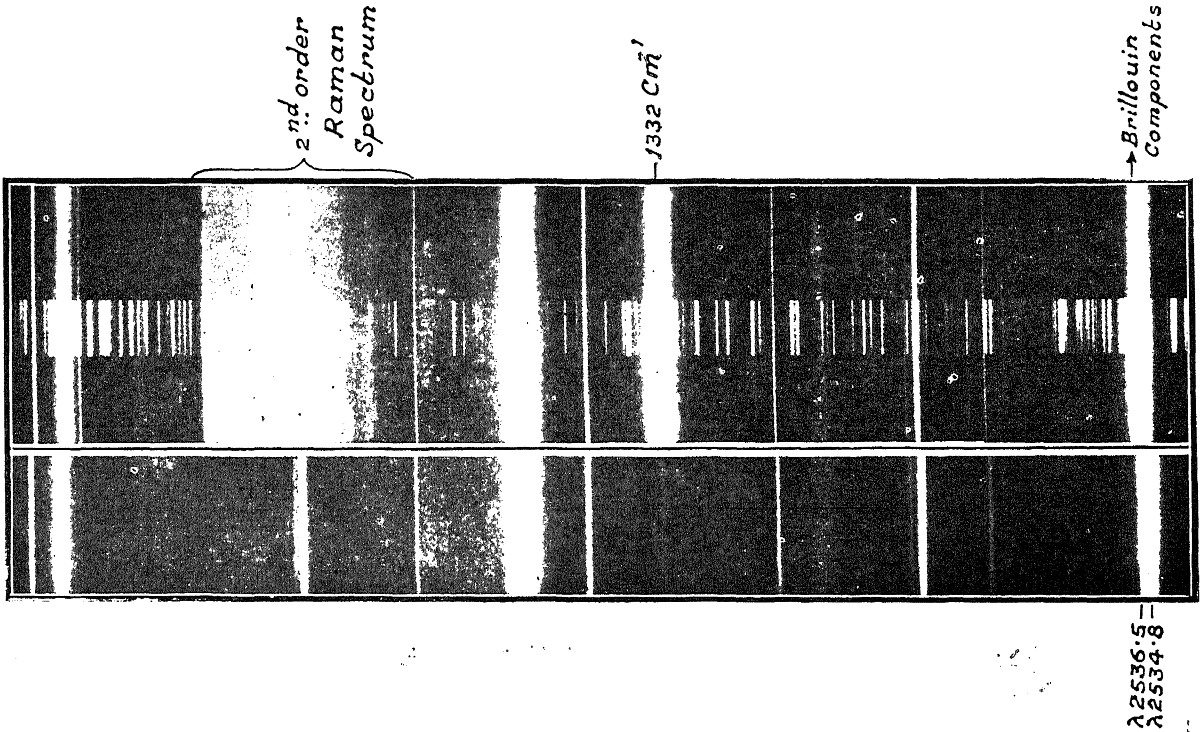



FIG. 6. *(a)* Mercury spectrum. *(b)* Raman spectrum of diamond (After Dr. R. S. Krishnan)

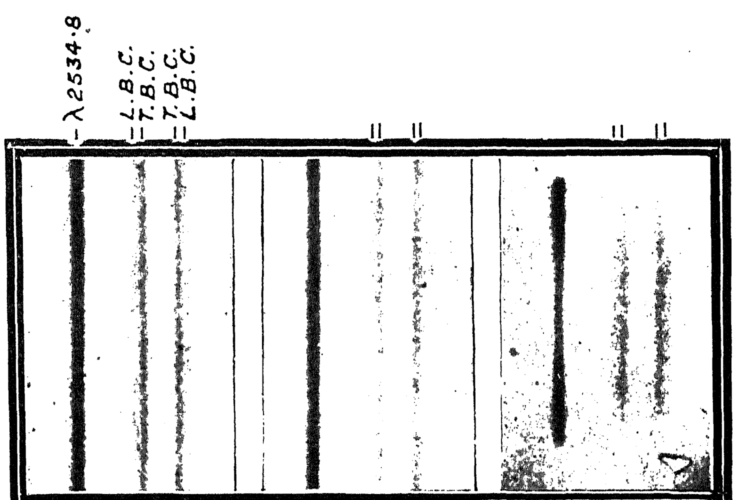



FIG. 7. Scattering of light by longitudinal and transverse sound-waves in different directions in diamond. (After Dr. R. S. Krishnan)

It is much less intense than the close doublet 2460-2470 cm.$^{-1}$, adjacent to which there are also several other lines (see Fig. 8). The terminal line at 2015 cm.$^{-1}$ is so feeble that it is not seen in the reproduced spectra but is quite clearly shown by a microphotometer record. The apparently continuous background seen in the second-order spectrum appears under high resolution as an aggregate of closely spaced lines which is part of the *third-order spectrum* and which appears superposed on it.

The infra-red absorption by diamond in the frequency range between 900 cm.$^{-1}$ and 4000 cm.$^{-1}$ has been surveyed by K. G. Ramanathan and a set of ten curves showing

much significant detail obtained with different diamonds is reproduced with his paper. The plates employed were of not very different thicknesses, but they differed much in their physical properties such as ultraviolet transparency, luminescence, birefringence, and photoconductivity. The ten infrared absorption curves exhibit a practically continuous sequence of variation, ranging from complete transparency in the region 900-1350 cm.$^{-1}$ to nearly complete opacity in the same region, and such variation also shows a complete correlation with the variations of the other properties referred to. With another paper by the same author, the emission and absorption spectra of blue-luminescent diamonds and their microphotometer records are reproduced. The discrete character of the blue-luminescence spectrum is evident from the reproductions (see Fig. 9), and the measured frequency differences from the principal emission line at $\lambda$ 4152 indicate very clearly that we are concerned here with the characteristic vibration frequencies of the diamond structure.

Thus, in the case of diamond, we have a wealth of experimental material regarding the nature of the vibration spectrum obtained by diverse methods of observation, *viz.*, first and second order scattering of light, infra-red absorption of the first and second orders—the former varying from diamond to diamond while the latter remains invariable—luminescence of various types, as also the related absorption. An intercomparison of the results obtained by different methods taking into account the different circumstances of observation, shows a remarkable concordance, which is exhibited diagrammatically in Fig. 10. The observations themselves clearly indicate that the diamond structure has a set of discrete modes and frequencies of vibration which are finite in number, these appearing in the first-order spectra as fundamentals and in the second-order spectra as their overtones and summationals. The fundamental frequencies deduced from the observations are in cm.$^{-1}$, 1332, 1250, 1232, 1149, 1088, 1008, 752 and 620, being just 8 in number. The dynamical theory set out in the introductory paper of the symposium leads to the result that the structure of diamond has nine characteristic modes of vibration of which the fifth and the sixth are indistinguishable, thus giving us only eight eigenfrequencies.

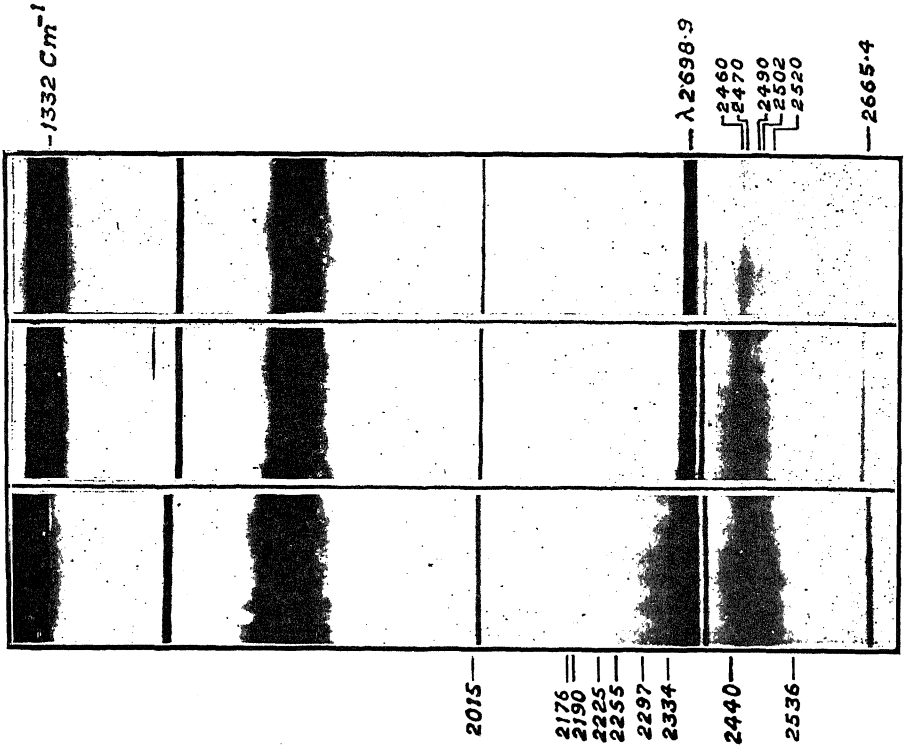



FIG. 8 Raman spectrum of diamond under high resolution (After Dr. R. S. Krishnan)

The identification of these with the eight experimentally observed frequencies therefore naturally suggests itself, but such identification evidently demands an independent proof before it can be accepted as convincing. The two other papers on the case of diamond appearing in the symposium, respectively by the present writer and by Mr. K. G. Ramanathan, furnish the required demonstration.

independent force-constants required to evaluate the frequency of any one of these modes is very considerably reduced. Actually, three force-constants (P, Q, R) which express the interactions with the nearest four atoms are sufficient to give a fair approximation to the facts, while eight constants (P, Q, R, S, U, W, $\Sigma$, $\Omega$) which take account of the 28 nearest atoms are all that are needed. The values of P, Q, R which

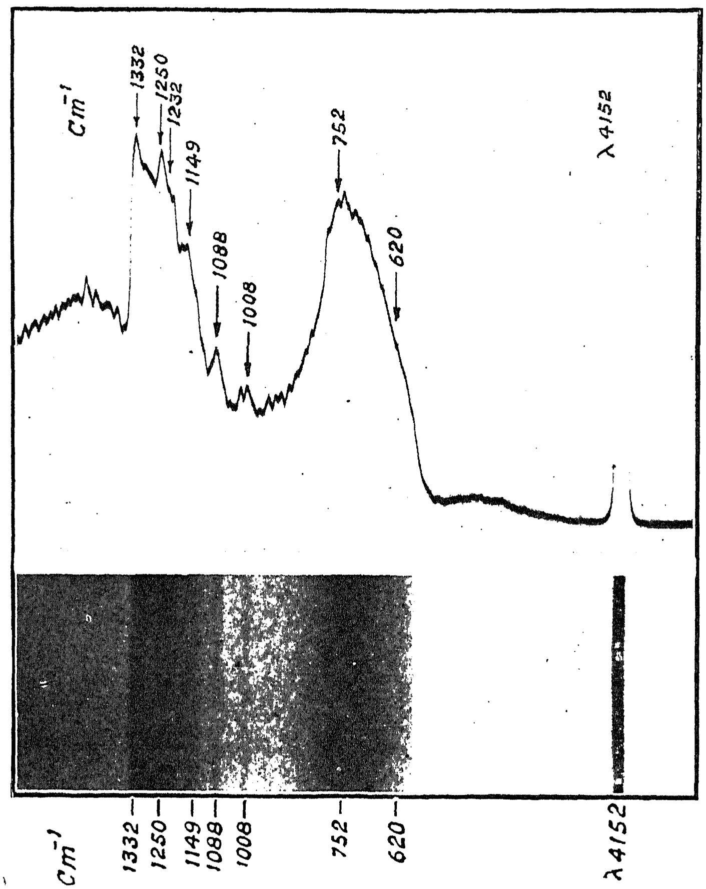



FIG. 9. Blue-luminescence spectrum of diamond and its microphotometer record
(After K. G. Ramanathan)

The nine eigenvibrations of the diamond structure are readily described. Eight of them arise from the existence of three sets of alternative possibilities, namely, an oscillation of the cubic (octahedral) planes in a direction normal (tangential) to those planes, the nearest layers of carbon atoms being in the same (opposite) phase of motion. The ninth mode is a movement of the two sets of carbon atoms forming the structure against each other. Owing to the high symmetry of the structure, the number of

fit the experimental data are found to be related to each other in a manner which one would expect from the known physico-chemical structure of diamond (*viz.*, $P > 4Q$ and $2Q > 2R > Q$). The values of the remaining five constants which express the interactions with distant atoms come out very small as is to be theoretically expected. Tables I and II, reproduced from the paper by K. G. Ramanathan, exhibit this situation very clearly.

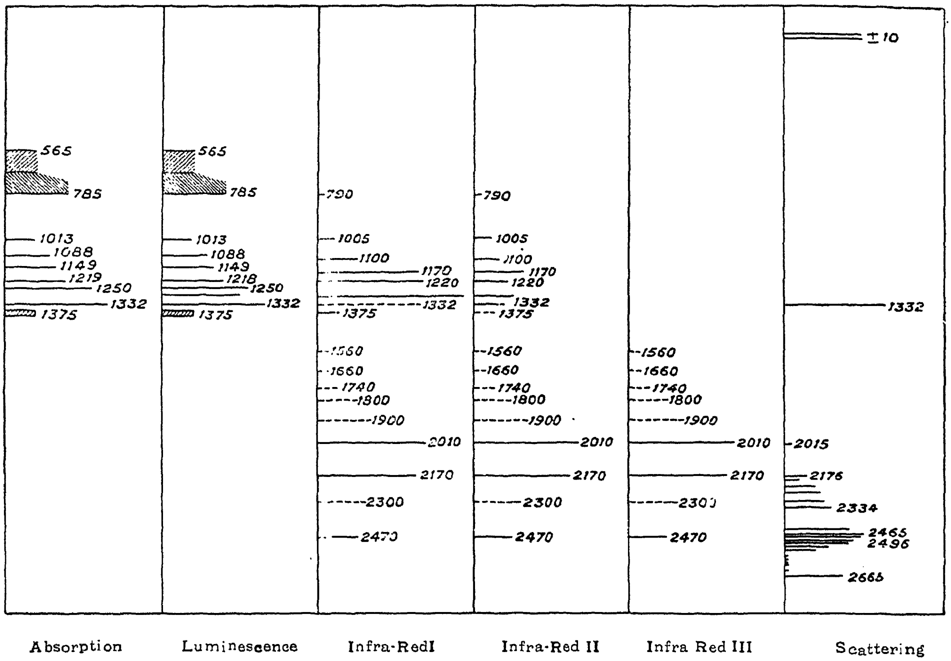



FIG. 10. Spectral frequencies of diamond in cm.$^{-1}$ as observed by various methods

**TABLE I**

*Numerical values of the force-constants $\times 10^{-5}$ dynes per cm.*

| Atom 0 | Atoms 1 to 4 | | Atoms 5 to 16 | | | Atoms 17 to 28 | |
|---|---|---|---|---|---|---|---|
| P | Q | R | S | U | W | $\Sigma$ | $\Omega$ |
| 7·35 | −1·39 | −0·858 | −0·005 | −0·131 | −0·114 | −0·06 | +0·005 |

**TABLE II**

*Calculated value of the frequencies of diamond*

| Sequence | Degeneracy | Operative Force-constant | Frequencies from abbreviated formulæ | | | Complete Formulæ |
|---|---|---|---|---|---|---|
| | | | P only | P, Q, R | P, Q, R S, U, W | |
| | | | cm.$^{-1}$ | cm.$^{-1}$ | cm.$^{-1}$ | cm.$^{-1}$ |
| I | 3 | $P-4Q+4S+8U-12\Sigma$ | 1020 | 1 51 | 1294 | 1332 |
| II | 8 | $P-2Q-2R+4W+6\Sigma+6\Omega$ | 1020 | 1294 | 1269 | 1250 |
| III | 6 | $P-4R-4S-12\Omega$ | 1020 | 1234 | 1236 | 1232 |
| IV | 4 | $P+2Q-4R-8W-6\Sigma+12\Omega$ | 1020 | 1064 | 1123 | 1149 |
| V & VI | 3+3 | $P+4S-8U$ | 1020 | 1020 | 1088 | 1088 |
| VII | 4 | $P-2Q+4R-8W+6\Sigma-12\Omega$ | 1020 | 973 | 1038 | 1008 |
| VIII | 6 | $P+4R-4S+12\Omega$ | 1020 | 744 | 746 | 752 |
| IX | 8 | $P+2Q+2R+4W-6\Sigma-6\Omega$ | 1020 | 635 | 582 | 620 |

The agreement of the frequencies computed theoretically with those observed and the reasonable values of the force-constants which have to be assumed to fit the data are both impressive. But even a more striking confirmation of the correctness of the identifications comes to hand when we consider the *activity* of the various modes in light-scattering and infra-red absorption on the basis of the known structure of diamond and compare the same with the facts of observation. This is done at considerable length in the second paper of the symposium, and the concordance which emerges is so satisfying as to leave no doubt whatsoever of the correctness of the theoretical approach made to the problem.

5. THE ALKALI HALIDES

The symposium under review includes papers by Dr. R. S. Krishnan describing and discussing the results of his investigations on the scattering of light in two of the alkali halides, namely, rock-salt and ammonium chloride, which are both cubic crystals. Fig. 11 (*a*) and (*b*) reproduce the spectrum of rock-salt as recorded by him respectively with the larger and small Hilger quartz spectrographs, but enlarged in both cases to the same size. It will be noticed that the frequency shift of 235 cm.[-1] appears distinctly sharper and that the other details are also seen more clearly in the spectrum recorded with the larger instrument. This is also evident from the microphotometer records reproduced with the paper which show significant differences in the distribution of intensity as recorded with the two instruments. In particular, the frequency shift 235 cm.[-1] shows a large gain in intensity relatively to the other features and indeed overtops all of them in the microphotometer record of the spectrum (see Fig. 12) which is not the case when the smaller instrument is used. This is precisely what we should expect to find when a higher resolving power is brought to bear upon a closely spaced aggregate of spectral lines of differing intensities. In other words, the comparative microphotometric study reveals that the

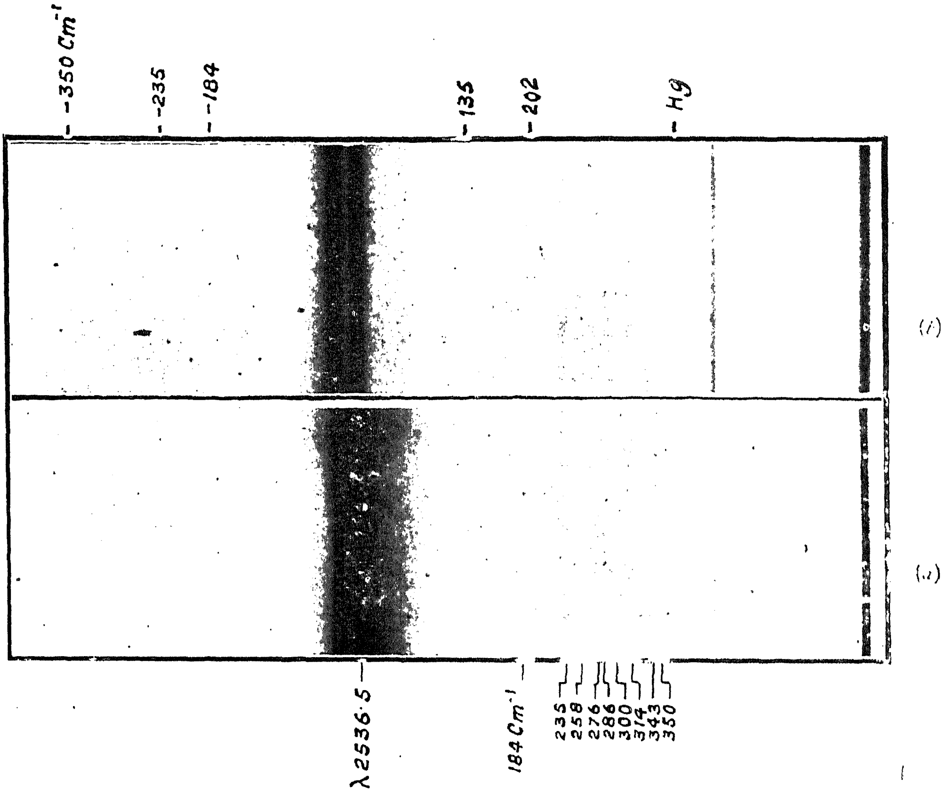



FIG. 11. (*a*), (*b*) Raman spectrum of rock-salt recorded under high and low resolving powers (After Dr. R. S. Krishnan)

# RATIONALISATION OF MEDICINE IN INDIA*

THE development of medical science in India is a fascinating study. In its long history it has suffered repeated impacts with foreign systems, the latest being the Western allopathic system.

At present, in this vast country, medical relief to the masses is carried out by two agencies—the Indigenous and Western.

Indigenous medicine is being practised by a vast number of practitioners. Unfortunately only a small portion of these have received proper systematic training. It is this class of untrained or improperly trained practitioners, which at the present time attends to the needs of the major portion of the rural population. There is evidence to prove that unauthorised practice is responsible for producing much misery and suffering. There are, however, some important considerations in favour of the indigenous medicine, if properly practised. The first is that the materia medica used is derived entirely from indigenous sources and, therefore, is inexpensive. The second is that these systems are ingrained among the people who have faith in the treatments prescribed and the drugs used. That there is much in the Indigenous Medicine, especially in its materia medica, is beyond doubt. But even with a background of its glorious past, Indigenous Medicine, it is believed, cannot play as effective a part, nor take its proper place in the present-day medical relief in this country. They will first have to put their house in order and become cognisant of the present-day environments and their requirements. The practitioners will have to be properly trained, and unauthorised practice will have to be rigidly eliminated. The true spirit of research and discovery will have to be inculcated and irrationalism excluded from diagnosis and treatment of diseases. The discoveries which have proved effective beyond doubt in the treatment of disease must be accepted and incorporated, and all inherent prejudices discarded to achieve the one sublime object of the alleviation of human suffering.

The second agency of medical relief is through the practitioners of Western medicine. Though it has a scientific basis and is, therefore, much more amenable to rational practice, it unfortunately does not reach much more than 20 per cent. of the population. The reason for this tardiness is not far to seek. The economic condition of masses of people is very low, and there are millions who cannot afford any kind of treatment.

## Irrational Practice of Modern Medicine

Quite in contrast to the Indigenous Medicine, Western Medicine has made enormous strides, both in connection with the causation of disease and its treatment. But in spite of this there is a regrettable tendency on the part of the practitioners towards mere empiricism. Non-critical and irrational use of therapeutic agents is rather the rule than the exception. In fact if the state of medical practice in India is examined without prejudice, one is forced to the conclusion that with the exception perhaps of a small number of institutions and of a comparatively small number of practitioners, the practice of Western Medicine is not a shade better than that of Indigenous Medicine. One dare not estimate the harm that has been done through the indiscriminate use of powerful remedies which science has placed in the hands of practitioners. It is a sad commentary on things that though Western medical science has been well established in the whole country for at least half a century, if not more, it has not yet succeeded in making the average educated men more health conscious, to say nothing of the uneducated and ignorant masses. There has been little progress during the last forty years or so, in the rationalisation of the practice of Western Medicine generally in this country. The blame does not lie wholly at the door of the general practitioner.

## Why Rational Medicine is not Practised

One of the chief reasons why rational medicine has not been practised is that those responsible for the government in this country in the past have neglected the growth of the nation-building health services. The *per capita* expenditure has in the past been absurdly low compared with what should have been spent. "India should have spent annually Rs. 3-3-0 per head of the population, if her expenditure on health services were to bear the same relation to the national income as the amount spent in Great Britain in 1934-35." But the combined expenditure on medical relief and public health activities in the provinces during 1944-45 ranged between 2·8 annas *per capita* in the C.P. to 10·9 annas in Bombay. It is, therefore, not surprising that medical education and medical research which form the foundation of rational medicine have suffered seriously. The teaching institutions are too few and many of those that exist are poorly equipped and inadequately staffed.

Medical education should be carried out on much broader and sounder lines than heretofore if the present low standard of medicine in India is to be raised. This can only be done by improving the educational institutions, both as regards their teaching staff and equipment. In Great Britain, the proposed National Health Service will bring into being the Health Centre, an institution which it is intended should provide the general practitioner with all modern methods of diagnosis and treatment. If the medical practice in this country is to be rationalised adequate provision will have to be made on similar lines.

## Medical Research

There is no doubt that rational medicine cannot be practised unless there is extensive medical research. The annual grant for medical research by the Government of India, till recent years, was only a paltry sum, and even this was cut down through the recommendation of the Inchcape Commission. The research worker is poorly paid, and the best talent takes up practice because it is more remunerative. With

* Extracts from the General Presidential Address by Sir Ram Nath Chopra, to the Thirty-Fifth Session of the Indian Science Congress, Patna, 1948.

all these disabilities it is not surprising that the standard of medical practice is low, and scientific or rational medicine has not been practised.

The immediate implementation of a progressive plan like the one put forward by the Bhore Committee will enable us to draw abreast of recent knowledge and to introduce in our country up-to-date teaching and research, and what is best in the health administration of advanced countries.

Trained personnel is the most important single factor for provision of adequate medical relief on rational lines. We need at least ten times the number we have, and it will take 30 to 40 years to train this number. It is imperative, therefore, that we make the most of what we have. The present retiring age in services is 55 years, when most of the incumbents are yet fit to carry on efficiently for many more years. They should be made to work as long as possible and, if necessary, their sphere of work should be changed to suit their physical capacity. When we come to highly specialised workers, such as research workers, of whom we have a still less adequate number, it would be foolish to retire them, as is the usual practice, when they are most valuable for training and directing other workers and organising new institutions.

### The Role of Indigenous Medicine

There are many people who consider that while a comprehensive and rational system of public health is being evolved, use should be made of Indigenous Medicine. Indigenous system—good, bad or indifferent—still caters for the needs of the major portion of the population particularly in rural areas. They, therefore, consider that it cannot be excluded altogether from the field, and urge that it be used to the best advantage while the process of evolution of a perfect system of rationalisation of medicine is being worked out. During this transition period, they also hope that Indigenous Medicine will overhaul itself and becomes an integral part of the permanent system evolved.

For the rationalisation of medical practice in India two important points suggest themselves. Firstly, the practice of medicine be so regulated by the exponents of modern and of the indigenous systems that the fullest possible use can be made of the facilities available for diagnosis, treatment and prevention of disease. The second point is that a synthesis of indigenous and modern systems of medicine be attempted so as to promote the utilisation of the knowledge from all available sources for the interpretation of health and disease. Both extension and acceleration are possible through a partial synthesis of the two systems in the elementary stage of our teaching. The present course of study in the indigenous medicine should be suitably curtailed on one side and enlarged on the other. The net effect of this suggestion will be twofold. It will shorten considerably the period of study, and thus will lead to the training of a much larger number of qualified practitioners. And secondly, while giving the students a sufficient background of scientific knowledge with regard to the diagnosis, treatment and prevention of disease, it will make them at the same time conscious of their own limitations and of the necessity to appeal to higher practice in difficult cases. There are about a hundred thousand practitioners of indigenous medicine in India, many of whom could be quickly fitted for this purpose after suitable training. The services of such practitioners will be of particular value in the rural areas, which are now almost beyond the reach of modern medicine. Rural medical relief will be considerably facilitated if some further steps are taken to standardise medical practice by prescribing uniform scales of drugs and medical appliances for institutions, their production in bulk and distribution under the auspices of the State. If all practitioners are properly registered, and practice by non-registered practitioners prohibited, a reasonable standard of competence could be secured.

N. N. De.

*Note.*—The cost of printing this contribution has been defrayed by a generous grant from the Rockefeller Foundation for the publication of results of scientific work made to us through the kindness of the National Institute of Sciences, India.

## TECHNOLOGY OF RICE*

THE number of named varieties of rice is said to exceed two thousand. Hundreds of varieties are cultivated. There exist between these varieties marked differences in quality as revealed by consumers' preferences. Attempts have been made to correlate quality in rice with certain chemical and physico-chemical properties of the cereal, but rarely with success. Extensive investigations were carried out at the Central College, Bangalore, to correlate varietal differences in physical properties with the quality of rice. A study of sorption and desorption of water by rice grains showed that, in general, superior varieties of rice lose water more readily during dehydration, and take up water at a faster rate, during hydration, than varieties of poorer quality. This showed greater permeability of the grain to moisture in superior varieties. Other physical properties did not exhibit any useful correlation with quality.

The observation on sorption led to an extensive investigation of the swelling of rice grains when cooked. Correlation between absorption of water and cooking quality furnished a convenient method of expressing it in quantitative terms by "Swelling Numbers". This simple method of determining cooking quality has been in use at the Central College for over ten years and has been found to give highly reproducible results.

Important conclusions arrived at from these experiments were: (*a*) Rice from freshly harvested paddy (which is notorious for its poor cooking quality) gives a very low swelling number, (*b*) storage or proper heat treatment improves the cooking quality of freshly harvested paddy, (*c*) overcuring adversely affects

* Abstract of Presidential Address delivered by Dr. B. Sanjiva Rao to the Chemistry Section of the Indian Science Congress, in January 1948, at Patna.

rock-salt spectrum is an aggregate of discrete lines and that the frequency shift of 235 cm.$^{-1}$ shows up a distinct line even under a low resolution just because its intrinsic intensity is much greater than that of the other lines crowded together in the spectrum.

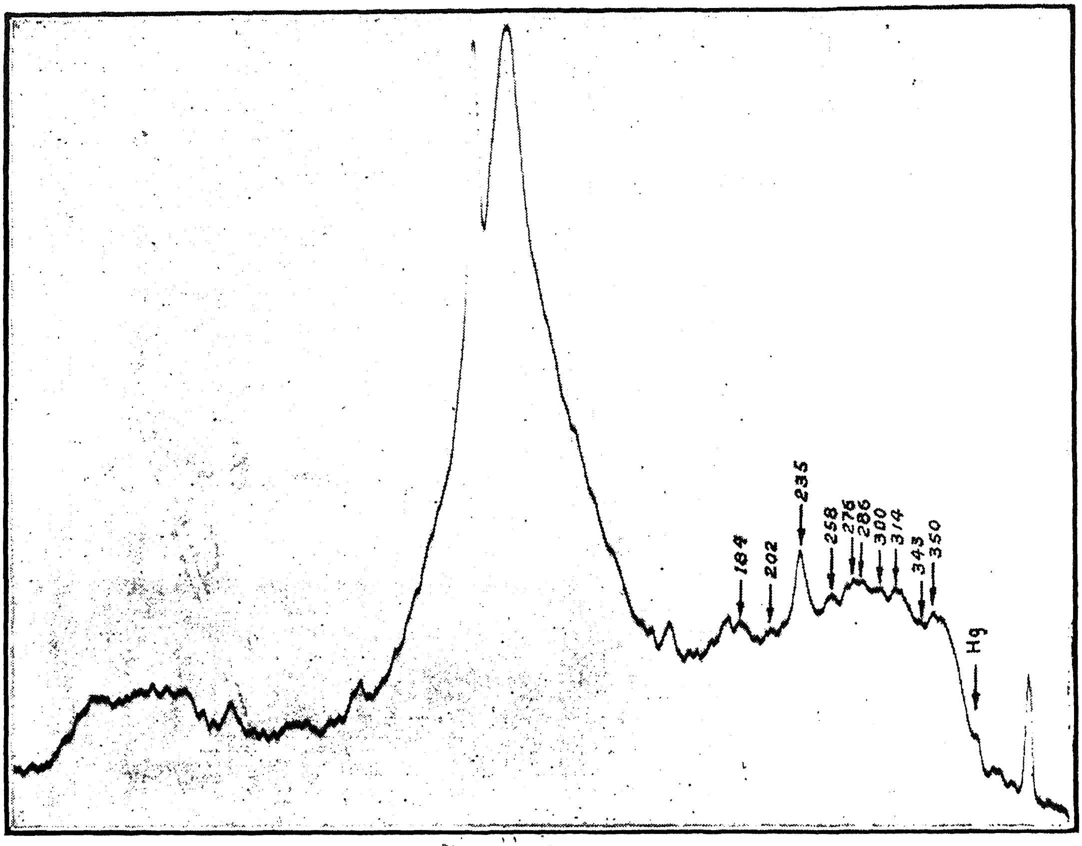



FIG. 12. Microphotometer record of the rock-salt spectrum under high resolution (after Dr. R. S. Krishnan)

The large intensity with which the frequency shift of 235 cm.$^{-1}$ appears finds a simple explanation in the theory of the vibrations of the rock-salt structure developed and discussed in the symposium. One of the nine possible eigenvibrations of the structure represents an oscillation of the chlorine ions contained in the octahedral planes of the crystal in a direction normal to these planes, the intervening layers of sodium ions remaining at rest. Owing to the large mass of the chlorine ions, this particular oscillation has a low frequency, being in fact the sixth among the modes in the descending sequence of frequency. The chlorine ions have, however, a large refractivity, indeed very much larger than that of the sodium ions, and hence the alternate approach and recession of the octahedral layers containing them results in much greater variations of optical polarisability than in the case of any other mode. These variations in the successive layers cancel each other's effects in the first approximation, but in the second approximation a residue is left over which results in a frequency shift of double the frequency appearing with quite notable intensity. It is evident from Fig. 12 that the spectrum also contains numerous other lines, most of which are barely resolved from each other. This is scarcely surprising when we recall that the second-order spectrum of rock-salt should exhibit 45 separate shifts, to say nothing of the third-order spectrum which is also in part superposed on it.

The results obtained with ammonium chloride are also of great interest in view of the remarkable changes which occur in the spectrum of this substance when the temperature is varied. We have not, how-

ever, space here to refer to them in detail, and the interested reader will no doubt, consult the original paper.

6. Some Concluding Remarks

The spectroscopic behaviour of diamond as observed in light-scattering which has been described and discussed above, and the behaviour of crystalline magnesium oxide as observed in infra-red absorption, described and discussed in *Current Science* for December 1947, clearly demonstrate that the complete vibration spectrum of a crystal in the higher ranges of frequency is a discrete *line-spectrum*. In view of the thoroughness with which these two cases have been investigated, and the simplicity of the structure and composition of both the crystals, the experimental facts which have been observed with them are acid tests for any theory which concerns itself with the atomic vibrations in crystals and claims to be able to explain the physical phenomena resulting from such vibrations; any theory which cannot account for the facts noticed with these two crystals or leads to results different from those observed must necessarily stand discredited. *Per contra*, a theoretical approach to the subject which leads to a simple and natural explanation of the facts observed with diamond and magnesium oxide must at least be on the right lines. This is the claim made on behalf of the theory of the eigenvibrations of crystal structures set out and discussed in the introductory paper of the symposium.

C. V. Raman.

## THE INDIAN SOCIETY OF AGRICULTURAL STATISTICS

The first Annual Meeting of the Society was held at New Delhi from the 11th to the 14th December 1947. The meeting opened on the 11th with the Presidential Address by the Hon'ble Dr. Rajendra Prasad, Minister for Food and Agriculture, and President of the Society. The President referred to the poor quality of the published agricultural statistics and stressed the urgent need of improving it both as regards completion and accuracy, as, without reliable statistics, no planning of any kind was possible. Although food was the greatest problem facing the country, no policy for food could be formulated for want of reliable data. Emphasising the need for building up of an adequate statistical organisation, he urged statisticians to develop scientific methods like those of random sampling and air photography for reducing the cost and time in collecting data.

On the 12th December, a symposium on 'Statistical Organisation for India with special reference to Agriculture' was held under the chairmanship of the Hon'ble Mr. R. K. Shanmukham Chetty, Minister for Finance. Opening the symposium, he said that the building up of a statistical organisation must really be given top priority, for, the Government cannot plan in a rational manner its food policy without reliable statistics. He said that the Government was just considering proposals for strengthening the central statistical organisation and was examining as to how far individual departments should be engaged in the collection of statistics and to what extent the central organisation should control the collection in individual departments and in what manner it should co-ordinate it, and added that the Society's guidance in these matters would be most valuable. The main speakers were Dr. V. G. Panse (Indore) and Mr. W. R. Natu (New Delhi). They emphasised the need for decentralisation not only in regard to the collection of statistics but also for the training of statistical personnel and research in statistical methods, as, in their view, a close contact with the field to which Statistics is applied is absolutely essential for the growth of efficient statistical service. Others participating in the symposium were Prof. K. B. Madhava, Mr. K. Kishen (Lucknow), Mr. R. S. Koshal and N. S. R. Sastry (Bombay) and Dr. P. V. Sukhatme (New Delhi).

On the 13th December, a second symposium on the contribution of 'Statistical Science to the Development of Indian Agriculture' was held under the chairmanship of Prof. J. N. Warner of the Allahabad Agricultural Institute. Dr. N. S. R. Sastry, opening the symposium, dwelt on the role of statistical science in agricultural economics. He was followed by Messrs, V. D. Thawani, M. A. R. Roy, Mr. V. R. Rao, Mr. S. S. Iyer, Mr. S. D. Bokil, Mr. K. Kishen, Mr. R. S. Koshal and Mr. M. V. N. Rao, who described the varied applications of statistics in different branches of agriculture including plant breeding, design of experiments, animal husbandry, fisheries, etc. One the 14th December, papers were read with Prof. K. B. Madhava in the chair.

It was announced at the meeting that arrangements for the publication of the Society's Journal were nearly ready. A special feature of the Journal would be a Hindi supplement giving summaries of the articles published.

P. V. Sukhatme.

the quality and (*d*) parboiled rice swells less than raw rice when cooked under the same conditions.

It is obvious that any process that cuts short the curing process will be of economic importance.

The unsuitability of rice from fresh paddy as food seems to be due to at least two causes. One is its poor swelling quality when cooked. Cooked rice that has swollen presents a large internal surface at which the digestive enzymes can be adsorbed and can act efficiently. Another reason for the poor quality of rice from fresh paddy seems to be the poor permeability of the envelope surrounding the starch granules.

The swelling of starches has received considerable attention in recent years. It is generally recognised that the starch granules enlarge by tangential expansion and not by development of internal, radially directed pressure. Swelling is influenced by the following factors: (1) original size of granule; (2) relative percentages of amylose and amylopectin; (3) extent of crystallisation of starch and the nature of the crystallites in the granules; and (4) whether the structure of the granule has been previously influenced by chemical or physical treatment. Some of these factors are of particular importance with reference to processes for curing rice. Hydrogen bonding seems to play a part in the swelling of starch. Cations have been found to have a marked effect on the swelling.

It should be noted that all these investigations on the swelling of starch have been carried out with granules that have been detached from their natural setting in the raw material. We are concerned, however, with the overall swelling of the rice grain in its cooked state as served at the table.

The principal material that binds the starch granules into a rigid structure seems to be the protein in rice. It is well known that proteins form complexes with carbohydrates. The latter also form complexes with fats, phosphoric acid and silicic acid. Sjostrom pictures the granules in the rice grain enclosed in honeycomb-like structures of gluten, and states that in the aggregates the granules are held together by the gluten particles. Protein (about 1 per cent. of the grain) seems to be the binding material in the production of a coherent structure from small glycogen units. The framework of the rice grain is, under certain circumstances, rather a delicate structure. In processes for the curing of rice, this has to be constantly borne in mind.

It has already been pointed out that one of the facors affecting the swelling of starch granules is the relative proportion of amylose and amylopectin, which constitute two distinct fractions of starch. Investigations were carried out at Central College to find out how far varietal differences in amylose-amylopectin ratios would affect the swelling numbers of the different varieties of rice. It was found that there was a close correlation between the amylose content of a rice and its swelling number. The question arises if the amylose-amylopectin ratio of a rice can be altered by appropriate treatment and the cooking quality of the rice thus improved. It was, however, found that heat treatment of paddy by methods like parboiling did not affect the amylose-amylopectin ratio. Haworth has suggested a scheme for the synthesis and breakdown of amylopectin and amylose by the P. and Q. enzymes of potato. P. enzyme under appropriate conditions acts on amylopectin to yield amylose. Much more knowledge of the action of the enzyme, however, will have to be obtained before we can hope to alter the quality of a rice by enzymatic action.

In starch there is a strong tendency for the formation of "Interlocked macromolecules". The formation of cross-linkages in the macromolecules reduces swelling capacity. We may look upon rice as a colloidal system which has limited swelling capacity owing to the presence of cross-linkages.

Rice in fresh paddy is in a large measure in the hydrogel condition. As the rice ages, there is elimination of water due to syneresis. As syneresis proceeds, cross-linkages are formed, and there is greater rigidity in structure until, ultimately, on adequate storage, we are able to husk the rice without undue damage. It may be noted that in the rice grain there are capillary spaces, as in silica gel. Employing a special technique, M. R. A. Rao actually measured the volume of air entrapped in rice capillaries. The work of Subba Rao showed that some of the cavities in rice were of molecular dimensions. The hysteresis loops in rice disappeared on successive sorption and desorption of water vapour, but not of carbon tetrachloride vapour, by the rice. When rice grains undergo a series of sorptions and desorptions, there is considerable gain in the elasticity of the walls leading to the final disappearance of the hysteresis loop.

### Parboiled Rice

The fact that rigidity in structure in the rice grain can be attained by the application of wet heat and the consequent development of cross-linkages, is of great practical importance and is the basis of several methods of curing rice. One of the oldest of such methods, practised in India, is the parboiling of paddy. The out-turn of parboiled rice is usually 6 to 10 per cent. more than that of ordinary milled rice and the process conserves the water-soluble vitamins of the B group, the proteins and the mineral matter in rice. When rice has been properly parboiled, the keeping quality of the rice also improves, partly because the vitamins in the cured rice are not readily available to the weevils. Another important advantage of parboiling is that when parboiled rice is washed, prior to its cooking (and rice invariably is washed before it is cooked), the loss of thiamin is about 8 per cent. only, while raw milled rice loses 60 per cent.

It must be mentioned, however, that the process as practised by the trade in India is far from perfect and is in great need of standardisation and quality control. The need for reform in parboiling has also been emphasised by the Rice Study Group of the FAO.

The chief defects of improperly parboiled rice seem to be: (1) objectionable odour, (2) uninviting taste, and (3) toughness of the cooked grain. The first two undesirable features can be eliminated to a large extent, by reducing the period of soaking of paddy and by employing hot water for soaking. This aspect of the problem has been investigated at the Central

College, and we recommend that rice be soaked for two to three hours at 70° C.

Another essentially needed improvement is the frequent determination of moisture in paddy that is being dried. In American factories, where paddy is cured by certain improved methods of parboiling, moisture determinations are carried out every 15 to 30 minutes on cured paddy that is being dried. It should be noted that the extent of moisture in rice profoundly affects its storage.

A defect of parboiled rice which has been partly responsible for its rather limited popularity, is that parboiled rice when cooked yields a tougher product than that given by raw polished rice. "Tenderness testers" are now being used in food technology in America, to express quantitatively the tenderness of foods. We find that the swelling number (S.N.) can be used as a rough index of the tenderness of the cooked rice. Parboiled rices have S.N. ranging from 240 to 250, while raw polished rices of good cooking quality have swelling numbers ranging from 300 to 320. Parboiled rice, therefore, appears to be an overcured product. By reducing the duration and the temperature of gelatinization of starch, it is practicable to obtain a parboiled rice having a higher swelling number, but the grain will be less hard and there will be a greater loss in milling, due to breakage. We have, therefore, to fix an optimum for the swelling number, taking into account the preference of certain consumers for softness in cooked rice, as also the gain in head rice that is secured by greater gelatinization of the starch.

In recent years, several attempts have been made to modernize the parboiling process, and rice is now cured in America on a large-scale by two patented processes—"Rice Conversion Process" and "Malek Process". These are fundamentally akin to the parboiling process used in India for ages. The swelling numbers of several samples of American converted rice were determined at the Central College, and found to be even smaller than those of parboiled rices of India. Consumers' tests on converted rice were carried out in India recently, on a fairly large scale, under the auspices of the Ministry of Food. It was generally felt that converted rice, on cooking did not yield a sufficiently soft product acceptable to consumers in India, accustomed to raw, polished rice.

### Calcured Rice

In an endeavour to obtain a form of cured rice that has the appearance of raw, polished rice, as also its cooking quality, while having at the same time all the desirable features of parboiled rice, a modified process of curing rice has been developed at the Central College. In this process, the paddy is soaked for 2 hours in a dilute solution (0·2 molar) of calcium chloride at 70° C., the pH of which is adjusted to 4·5. The solution is drained off, and the gelatinization of the starch is effected by heating the paddy with steam to a temperature of 98° C. The paddy is then dried and husked. In this process, the gelatinization of starch is carried out to a very moderate extent, the necessary rigidity in structure of the grain being secured by the employment of calcium ion to modify the colloidal properties of starch and of the protein. When rice is soaked in calcium chloride solution, there is an exchange of cations, the potassium in the rice partially goes into solution and is replaced by calcium. The colloidal properties of starch also are modified by calcium ion.

In the calcuring process, the gelatinisation of starch is so adjusted that there is no appreciable fall in the swelling number of the rice. Calcured rice, when cooked, is soft unlike other forms of cured rice. Each cooked grain, however, retains its individuality. The cooked rice has no objectionable flavour. The calcium content of calcured rice is about five times that of ordinary, raw polished rice. There is thus some nutritional improvement owing to higher calcium content.

The thiamin content of calcured rice is on an average 2·3 micrograms per gram of the cereal. The thiamin value can no doubt be increased by soaking for a longer period but this would adversely affect the appearance of the calcured rice. The loss in thiamin on washing calcured rice is 4 to 5 per cent. as compared with the 8 per cent. loss sustained by parboiled rice and 60 per cent. by raw polished rice. Calcured rice is also much less susceptible to insect attack than parboiled rice or raw rice. It is not, however, clear yet how the calcium modifies the rice to make it less susceptible to insect attack.

Dielectric heating for drying cured paddy, though scccessful, is not economically practicable. This has been found to be very advantageous in the gelatinisation of the starch because of the greater uniformity in heating and of the greater fixation of thiamin in the endosperm. In small-scale experiments, 2·7 $\mu g$ of thiamin per gram of rice were fixed, while ordinary heat treatment under identical conditions yielded calcured rice having 2·3 $\mu g$ of thiamin per gram.

The question may now be considered: What is the best form in which rice can be supplied to the consumer? The Rice Study Group of the FAO has recommended that "a large percentage of the rice supply should be parboiled, since such rice keeps in good condition for longer periods"; and that "the consumption of parboiled rice or rice treated by similar methods and having higher nutritive value should be encouraged by governments, since such rice has distinct advantages over lightly milled or hand-pounded rice". In India nearly 60 per cent. of the rice consumed seems to be in the parboiled form, but parboiled rice is not at all popular in several Asian countries. No doubt, many people accustomed to raw rice have, during the present shortage of this cereal, changed over to parboiled rice. But it is debatable how far the changeover is of a lasting character.

Williams advocates mixing with raw polished rice, prior to its cooking, a small quantity of specially treated rice, very rich in vitamins. Until India is in a position to manufacture the synthetic vitamins used in fortification of rice, this method of rectifying the nutritional defects of raw polished rice is scarcely to be commended. The proper solution seems to be a process which renders parboiled rice more attractive in appearance and in flavour.

K. S. R.

---

*Note.* The cost of printing this article has been met from a generous grant-in-aid from the Indian Council of Agricultual Research, New Delhi.

# PHYSICS OF THE BOTTOM LAYERS OF THE ATMOSPHERE*

THE Physics of the Upper Atmosphere has been dealt with more than once by previous Presidents of this Section. On this occasion, I propose to make a rapid survey of some of the problems concerning the Bottom Layers of our Atmosphere and the Soil Layers immediately in contact with them. Weather is a three-dimensional problem, and to understand it fully one must explore the whole atmosphere. The troposphere, the seat of major weather phenomena, may be treated as a vast thermodynamic Heat Engine with water vapour as the working substance. Although every branch of classical and modern physics has the fullest scope for enquiry and research in the atmosphere around the earth, I confine myself here, as far as possible, to some of the happenings near the base of the atmosphere.

## RADIATION

When solar radiation passes through the atmosphere it is depleted by the processes of (1) absorption by certain components of the air, (2) molecular scattering by air molecules and (3) scattering by dust and other impurities. Solar radiation is absorbed by the oxygen, ozone, carbon dioxide and water vapour in the air but the most conspicuous is absorption in the near infra-red by water vapour and in the extreme ultraviolet by ozone. The last mentioned is of immense significance to life on the surface of the earth, as these radiations are very injurious except in minute doses.

The blue colour of the sky is due to the preferential scattering of shorter wave-lengths by the air molecules. Owing to paucity of actual radiation data in India (limited data are only available for Poona and Shajahanpur) computations have been undertaken for various latitudes over India on the basis of Bouquer's equation.

The total hemispherical radiation emitted by the earth's surface (0·669 gr. calories/cm.$^2$/mnt.) is comparable to the direct radiation (2 gr. calories/cm.$^2$/mnt.) from the sun at the upper limit of the atmosphere. In the disposal of the thermal radiation emitted by the earth's surface, water vapour in the troposphere, $CO_2$ which occurs throughout the atmosphere and ozone in the upper air play a significant part.

Thus the absorbing components like ozone, $CO_2$ and water vapour absorb the direct radiation from the sun and the thermal radiation from the earth's surface and also emit heat radiation in the wave-lengths that they absorb. It is important to know the exact distribution of the absorption coefficients with wavelength for the entire spectrum in order to evaluate the radiative equilibrium in different parts of the atmosphere. Our knowledge of absorption coefficients is incomplete and requires further thorough investigation of the absorption spectra of various gases at various temperatures and pressures.

In India, investigations on atmospheric radiation were commenced in 1930 by Ramanathan who was the first to give a complete picture of the thermal structure of the earth's atmosphere and to have conducted extensive measurements of ozone distribution in the upper atmosphere over India. Several workers have since continued radiation work mainly at Poona. Ramanathan's thermal picture brings out the interesting fact that the troposphere is highest and the air coolest just above the equator.

## PHENOMENA NEAR THE GROUND

Coming to the base of the atmosphere which is comparatively easier to investigate, one has to remember that insolation is the most important factor governing the climate of the air and soil layers near the ground. Workers at Poona have taken experimental measurements of this factor under various conditions. The surface of the ground is an "active surface" as it absorbs solar radiation and thereby warms the air and soil layers near it, and its absorbing power depends on the colour of the soil. The insolational heating and radiational cooling of the ground are propagated upwards into the airlayers and downwards into the soil layers. The diurnal range of temperature is maximum at the ground and decreases in the soil very rapidly with depth, becoming negligible at 1 foot or more. In air layers, the range falls rapidly in the first few inches and more gradually aloft, becoming negligible several kilometers above the ground as against 1 foot in the soil. Theoretical as well as experimental work of Malurkar and Ramdas in 1930 have enabled a clear understanding of the convection processes near a hot surface. The temperature at the soil surface can be as high as 75 to 80° C., and the lapse rate in the first cm. or two, 200,000 times the adiabatic lapse rate. The processes involved in the nocturnal cooling of the ground and the airlayers near it, the temperature fluctuations and the turbulence in the air layers near the ground have been studied at the Central Agric. Met. Observatory at Poona. A complete picture of the growth and destruction of the thermal inversion layer near the ground has also been given for the first time as a result of work at Poona, and is based on temperature readings taken with an Assmann Psychrometer at short height intervals. These measurements have also shown that the time lag of the maximum temperature epoch as one moves away from the ground is much larger than should be the case if the conduction close to the ground was truly molecular. Considerable work has also been done at Poona on the transmission of heat by convection from insolated ground to the atmosphere and on the exchange of water vapour between the soil and the air layers. Soil samples containing only hygroscopic moisture, exposed in the open, lose water by evaporation from the morning up to the maximum temperature epoch, and thereafter the soil reabsorbs the water vapour from the atmosphere. There is a complementary phenomenon going on in the air layers near the ground. During the day there is an upward

* Extracts from the Presidential Address delivered by Dr. L. A. Ramdas at the Physics Section of the Indian Science Congress, at Patna, 1948,

flow of water vapour from the ground, vapour pressure decreasing with height; at night vapour pressure increases with height.

The thermal balance at the ground surface is controlled by radiation, convection, conduction and evaporation. Calculation on the basis of experimental measurements at Poona on 23rd April 1936 showed a gain of 1366 and loss of 1355 gr. calories per sq. cm., resulting in a carry-over of 11 calories to the next day.

*Micro-Climates of Plant Communities*: Investigations at Poona show that plant communities tend to develop their own characteristic local or micro-climates which deviate from the climate of a neighbouring open space to the extent that horizontal air movement and incidence of solar radiation are cut off by the stand of the crop. The state of the ground also plays its part. Inside the sugarcane crop the almost continuous canopy of foliage acts like an *active surface*, and during the day, the canopy gets warmer than the ground, and forms a 'forced inversion'. Micro-climates of plant communities and their variation with age and density of crops are of great interest to agriculture.

*Problems of Hydrology*: The Agric. Met. Section at Poona has also been investigating the movement of moisture through soil, evaporation from free water and soil surfaces, effects of salts on permeability of soils to water, etc. Problems relating to the evaporating power of air layers near the ground, the fate of rainfall on irrigation, which is controlled by various factors like drainage, percolation, etc., have been studied on the basis of experimental measurements. The results of these experiments are of obvious importance to indigenous agriculture.

B. N. SRINIVASIAH.

* The cost of printing this article has been met from a generous grant-in-aid from the Indian Council of Agricultural Research, New Delhi.

## THE PLACE OF BIOCHEMISTRY IN INDIA*

EVERY student of Biochemistry knows what tremendous amount of literature has been produced during the last two decades on the subjects of vitamins, hormones and enzymes.

The role of vitamins in the alleviation of disease, and the eradication of such plagues as beri-beri, scurvy, pellagra, which took an enormous toll of life in many parts of this earth, was important enough to justify the support which this study obtained in different laboratories of the world. The biological significance of these chemical substances went, however, much further. Many conditions of obscure ætiology, and in apparently normal individuals, a feeling of vague illness, proved to be due to a deficiency of one or the other vitamin, and yielded readily to vitamin therapy. Thus vitamin therapy became popular for the promotion of optimum health with considerable success.

Coming to the subject of hormones, this field has not lagged behind that of vitamins, in the prolificity of literature, the importance of its discoveries and their application to human problems. In fact the output of papers has been so prolific in this field that new journals were founded to publish researches in endocrinology. Taking the group of sex hormones alone, it is well known how the biochemistry of these developed rapidly after the isolation of Oestrone by Doisy and by Butenandt in 1929 from human pregnancy urine. In less than a decade the entire group of naturally occurring œstrogenic and androgenic compounds and progesterones were isolated, their chemical structure and the laboratory synthesis of some of them worked out. The physiological action of these compounds, their biosynthesis, their metabolism and their role in pregnancy, reproduction, lactation, growth, puberty, senility are subjects of profound human interest, and biochemistry has enriched our knowledge of these remarkably. Researches on hormones have also led to the discovery of new techniques both in chemistry and clinical medicine. In the latter field, the nature of sex determination, sex involution, pubertal growth have been delineated experimentally with the help of these hormones.

The possibility of cholesterol being the starting point of the biosynthesis of steroid hormones was indicated by Fieser and by Koch in their admirable monographs. Recent studies of Bloch with the help of deuterium-containing cholesterol have provided an experimental support for this view. The administration of this cholesterol led to the appearance of deuterium containing pregnandiol in pregnancy urine. The output was of the order expected. Discoveries of fundamental importance are likely to result from a study of the role of hormones in cell processes which are being actively pursued to-day. The action of androgens in the synthesis of proteins, and of adrenal cortex steroids in the metabolism of carbohydrates, proteins and salts are already well established.

Enzymology is another fruitful field which biochemistry has explored with admirable success. While the foundations of this study were laid almost in the middle of the last century by the work of Liebig and Pasteur on fermentation, it is only during the last two decades that we have been able to get a clearer glimpse of the myriads of chemical reactions taking place in the tiny living cell. These chemical reactions which are collectively referred to as intermediary metabolism and whose integrated systems are responsible for all the phenomena of life, are not spontaneous, but organised and well-controlled processes brought about by highly specialised catalysts, the enzymes. Since the number of chemical reactions in a tiny living

* Extract of the Presidential Address to the Section of Physiology, by Dr. Bashir Ahmad, at the 35th session of the Indian Science Congress, in January 1948, at Patna.

cell are to be counted in hundreds, it supposes the presence of hundreds of enzymes. This, in fact, is true, and literally hundreds of enzymes have been isolated from the small yeast cell.

One of the most remarkable achievements of biochemistry in the field of enzymes is the reconstruction of the entire process of the fermentation of glucose to alcohol and glucose to lactic acid *in vitro*. Some twenty enzymes are involved which have been isolated and prepared in a pure state. A complete picture has been produced of the chemical details of how the various enzyme systems are linked and how the different chemical reactions are synchronised. This indeed is a remarkable achievement, but it is a drop in the ocean. Vast fields of virgin territory remain unexplored in enzyme chemistry.

Some other landmarks in the field of enzymes are the elucidation of the chemical nature of cozymase by Euler and his school (1937); of cocarboxylase by Lohman and Schuster (1937); of the yellow enzyme of Warburg by Warburg himself and by Kuhn (1935) and Karrer (1935); of the enzyme of tyrosine decarboxylase by Gunsalus (1944); all of which are examples of vitamins functioning as prosthetic groups. These explain the organism's continuous requirement of vitamins. Similarly the indispensability of certain trace elements in nutrition point to their being parts of some important enzyme systems. The development of the knowledge of enzyme chemistry also provides a basis for the understanding of the chemotherapeutic action of drugs. Observations on the relation of sulphonamides and *p*-aminobenzoic acid are important landmarks in this direction. These support the view that sulphonamides only compete with *p*-amino-benzoic acid in the formation of an essential enzyme complex. The action is not unlike that of an anti-vitamin. For the first time these studies open up an important avenue for a rational programme of chemotherapeutic research after many decades of much wasteful effort in organic synthesis.

Fundamental knowledge of plant biochemistry is essential to the plant pathologist, the plant geneticist, the horticulturist, and the economic botanist. This knowledge has grown into an important branch, though not as far developed as animal or bacterial biochemistry. The course of biochemical reactions in the plant are somewhat more complex than in the animal. Starting from carbon dioxide, water and a few inorganic elements, the plant cells synthesise an extraordinary range of complex organic compounds providing complete systems of synthesis and break down within themselves. Plant tissues, unfortunately, do not offer the same facilities for study, as the blood, the glands, the liver, or the organs of digestion and excretion in the animal; but new techniques for investigating the complex biochemical systems of plants are being devised which open up avenues of enormous possibilities. For example an enzyme system has been isolated from plants by the help of which starch can be synthesized *in vitro*. Even the enzymic synthesis of sucrose has been accomplished *in vitro*. Though the starting materials in this case were glucose-monophosphate, fructose and an enzyme system obtained from a bacterial organism, a line of attack has been opened which offers possibilities of development.

There are many other important fields in which biochemistry is making contributions of fundamental importance. Mention may be made of genetics, viruses, chemotherapy and immunology. An insight is being gained into the nature of genes and viruses, and how they direct biochemical reactions. The mechanism of the genetic control of the oxidation of homogenetic acid, presumably through a specific enzyme; of the synthesis of plant pigments such as carotinoids, anthocyanins and flavones; and several other oxidations and syntheses in the plant and in the animal are being gradually elucidated. Recent observations on the chemical and genetic mechanism of the reproductive system of *Chlamydomonas*, and of the amino-acid synthesis in *Neurospora* are of great significance. Encouraging investigation have been made on the chemical nature of viruses, and change of their chemical structure by certain chemical reactions. A clearer understanding of the biochemical mechanism of the therapeutic action of drugs is being reached. Chemical nature of the protein antigens and specific polysaccharides, of toxin and antitoxin reactions is being revealed and foundations of the science of immunochemistry laid.

I have picked up and presented to you a few glittering fragments from the large mass of scientific literature in biochemistry and indicated the role which they play in the progress and welfare of man. Biochemistry to-day is no longer the handmaid of medicine, or the ugly duckling of physiology. It is a full-grown science in its own right. Though still young, it has grown in stature bigger than some of the traditional branches. It has already done tremendous service to man, but its unexplored potentialities are even greater.

K. S. R.

---

*Note.*—The cost of printing this contribution has been defrayed by a generous grant from the Rockefeller Foundation for the publication of results of scientific work made to us through the kindness of the National Institute of Sciences, India.—*Ed.*

# LETTERS TO THE EDITOR



## THE APPARENT SHAPE OF THE MOONLIT OVERCAST SKY

IN an earlier note in this *Journal*,[1] the author has reported the measurements of the half-arc angle[2] under various conditions of clouding in the sky during day-time. They led to the anomalous conclusion that the half-arc angle decreases with increasing cloud-height, contrary to what should be expected on a geometrical basis. It was felt worthwhile to investigate whether the behaviour of the half-arc angle would be similar in the case of overcast night skies also. The results of such a study are reported in this article.

In the absence of the moon in the night sky, the clouding in the sky would be indiscernible, and the overcast would appear equally dark to the eye, irrespective of the height of its base. It is, therefore, only on moon-lit nights that such measurements could be carried out. As the intensity of illumination present in the sky may itself influence the half-arc angle to an uncertain degree,[3] measurements were made only on days when the moon was full or nearly so and was sufficiently clear of the horizon so as to illuminate the clouding uniformly. On most of the occasions reported here, the skies were totally overcast and, on the rest, they were nearly so. The times of observation were between 21.00 and 24.00 hrs. I.S.T. The heights of base of cloud were visually estimated. The half-arc angle was measured as before.[2,3] Eight measurements were taken on each occasion in four different directions, and their arithmetical mean was adopted as the representative value.

The results are reproduced in Table I below. In the last column of this table are given the corresponding values of the half-arc angles for the day-time skies, picked up graphically from the measurements of the author[1] and of Miller and Neuberger.[4]

TABLE I

| Date | Height of base of cloud in feet | Half-arc angle for full-moon night sky in degrees | Corresponding half-arc angle during day time in degrees |
|---|---|---|---|
| 13-6-1946 | 2,500 | 22·6 | 28·6 |
| 14-6-1946 | 3,000 | 22·8 | 28·4 |
| 9-9-1946 | 5,000 | 23·2 | 27·7 |
| 14-7-1946 | 7,000 | 23·7 | 27·4 |
| 13-7-1946 | 10,000 | 24·7 | 27·1 |
| 9-9-1946 | 13,000 | 25·5 | 26·6 |
| 9-9-1946 | 16,000 | 26·0 | 26·3 |
| 10-9-1946 | 22,000 | 26·5 | 25·4 |

The most interesting feature of the above results is that the half-arc angle for the overcast night skies shows an actual increase with increasing cloud-height, quite unlike during day-time. This is in accordance with what may be deduced on a purely geometrical basis. For, if $O$ is the position of the observer, $H$ that of the apparent horizon and $Z$ the zenith, the greater the value of $OZ$, the higher would be

the half-arc angle for the same value of *OH*. The true explanation is, however, not so simple; for, the situation is complicated by the fact that perception of depth is to a great extent subjective.[3] The thicker and darker a cloud, the more convex does the sky look to the eye. The influence of this subjective impression so far outweighs the geometrical fall of the half-arc angle due to decrease in the height of the cloud-base during day-time that the net effect is one of its actual increase. Such an explanation for this anomaly is justified because, during day-time, the value of *OH* is unaffected by the elevation of the cloud-base and is mainly determined by the existing conditions of visibility. During night-time, on the other hand, when the skies are overcast, due to the prevalence of darkness all round, the apparent value of *OH* would vary subjectively with the illumination that obtains on the furthest fringes of the cloud canopy. The value of *OZ* would similarly depend upon the zenithal luminosity of the overcast. With increasing cloud-height on moon-lit nights, *OH* ond *OZ* would, therefore, vary both objectively and subjectively.

The thicker the cloud during the moon-lit night, the darker it looks both at the zenith as well as near the horizon. This would make the distances of *OH* as well as *OZ* appear equally enhanced. The influence of subjective impression on *OH* may thus almost neutralise that on *OZ*. The variation of the half-arc angle with elevation of cloud-base may, therefore, become effectively objective.

A matter of practical interest that emerges from this study is the usefulness of the results reported here for the determination of the height of base of cloud during moon-lit nights. When the sky is overcast during the night, it is difficult for an observer on the ground, particularly in poor moon-light, to distinguish between different types of clouds and much more so to estimate their heights of base. Experience shows that searchlight observations are not quite possible in the presence of moon-light. as the beam of light fails to sufficiently illuminate the base of the cloud to enable observation from the ground, except when the cloud base is very low and the moon is very feeble. A mere measurement of the half-arc angle would, on such occasions, enable a fairly accurate judgment of the cloud-base. If a graph be drawn between the half-arc angle and the height of cloud-base using the data reported here, the height corresponding to any angle can be easily read off therefrom. Such a graph shows that the relationship between the half-arc angle and the height of the cloud-base is almost linear up to about 15,000 feet.

The usefulness of the above graph is not limited to the overcast full-moon skies only. For. some of the measurements made by the author, during the course of his work on the effect of illumination on the apparent shape of the sky, show that the half-arc angle for any overcast sky, when the moon is half is practically the same as when the moon is full. The graph can. therefore, be used for all states of the moon from half to full. Nevertheless. when the sky is thickly overcast with a deep layer of low cloud, the moon-light may so completely be cut off as to render the clouding imperceptible. On such occasions it may not be possible to determine the half-arc angle. But under such conditions, cloud-height can be easily measured by the searchlight method.

The author wishes to thank Mr. B. N. Sreenivasaiah, Meteorologist, Madras, for his kind interest in the work.

Meteorological Office,
St. Thomas' Mount,
Madras, D. VENKATESWARA RAO.
*November* 17, 1947.

1. Venkateswara Rao, D., *Curr. Sci.*, 1947, **16**, 55. 2. —, *Ibid*, 1946, **15**, 40. 3. —, *Proc. Ind. Acad. Sci.*, 1947, **25**, 34. 4. Miller, A., and Neuberger, H., *Bull. Amer. Met. Soc.*, 1945, **26**, 212.

## A PROPOSED NEW COMPONENT OF SOLAR RADIATION

IN a previous communication[1] the author examined variations in the selective absorption of light by molecules of the earth's lower atmosphere in the region of the oxygen absorption bands, and suggested that these were due, in part, to action on the molecules of a high-powered component within the earth's fair-weather electric field.[2] A comparative study of fundamental atmospheric electric phenomena has, however, indicated an additional, possible contributory factor.

In the accompanying comparison diagram are reproduced, with Greenwich mean time as abscissa and a variable ordinate (for which reference should be made to the original papers) the following curves:

(*a*) Curve '*e*' in Fig. 2 of Price and Chapman's[3] estimate of diurnal variations in the non-vanishing, terrestrial magnetic, line-integral current flowing across a representative region of the earth's surface;

(*b*) Curve 7 in Fig. 3 of Hogg's[4] variations in the rate of production of small ions in the lower atmosphere in fair weather;

(*c*) the mean of the electrogram and curve shown in Figs. 3 and 4 respectively of the diurnal variations in the apparent vertical component of the earth current observed by Forbush[5];

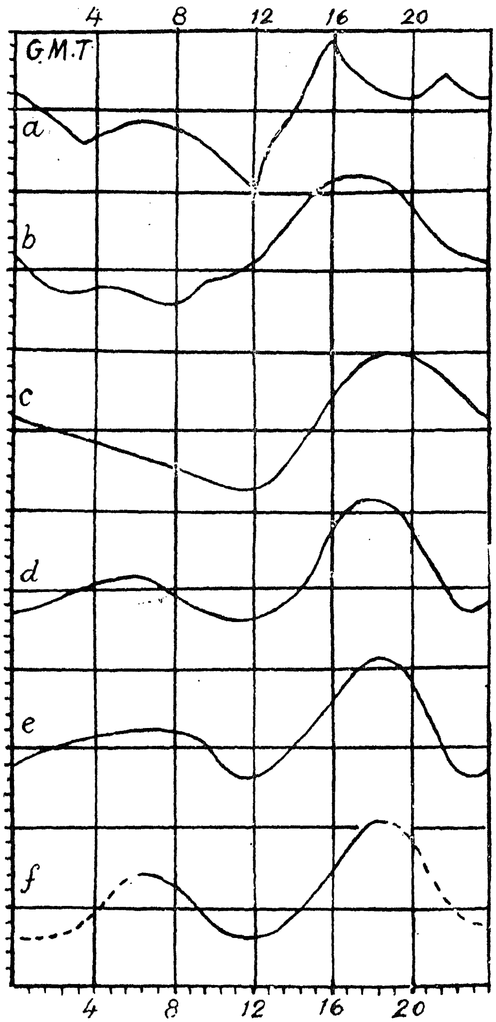
(*d*) curve of variations in the potential gradient of the earth's electric field from a typical. fair-weather electrogram of Colaba Observatory, set to G.M.T.;

(*e*) curve of Medi's[6] observations of day-time variations in atmospheric radiation, placed adjacent to Curve 1 in Fig. 1 of the author's own[7] qualitative observations of night-time variations in atmospheric radiation intensity, particularly in the region of the oxygen absorption bands (the red), the resultant indicating a marked correlation with the atmospheric potential gradient; and

(*f*) a curve constructed from Perot's[8] remarks on daily variations in the frequency of lines in the "B" band of the atmospheric oxygen absorption spectrum.

It will be seen that in every case there is. broadly speaking, a primary minimum in intensity at about noon. and a primary maximum at about 17.00 hours, both by G.M.T. The only

exception is the minimum, in the ionisation curve (b) of the diagram, which appears earlier in the day But it must be said here that the Nolans[9] in their estimates of atmospheric ionisation do indeed indicate a primary minimum at noon (see Curve 3 in Fig. 3 of




Comparison diagram accompanying note entitled A proposed New Solar Radiation by A. B. Arlick, Bombay, 20th November 1947.

their paper), besides the main maximum at about 17.00 G.M.T.

Since there is reason to believe that the above widely separated geophysical phenomena are truly representative of local terrestrial conditions, such a parallelism in them may mean that they all have a common origin.

The curve (d) also being a manifestation of the earth-to-air supply current, or compensation current, the suggestion of Bauer and others,[10] to the effect that there exists a non-ionizing but highly penetrating corpuscular radiation of extra-terrestrial origin which supplies this compensation current, may be adopted.

On a qualitative survey, it seems possible that a radiation of this kind, in penetrating the lower atmosphere, the earth's surface and upper crust, would cause (a) the magnetic line-integral currents by electric convection, (b) variations by irradiation or nuclear impact in the $\gamma$-ray activity of the atmospheric radon molecule which is the primary cause of ion-formation in the lower atmosphere, (c) vertical earth currents of the appropriate sign on penetrating the earth's surface, also by electrical convection, (d) changes in the potential gradient of the earth's electric field by progressive replenishment of the earth's escaping negative surface charge, (e) variation, by collision processes, in emissive and absorptive atmospheric radiation from the ordinary air molecules, and (f) variations, by excitation, in the frequency of lines in the absorption bands of atmospheric oxygen during night. It is, therefore, likely that this radiation provides the common origin and causes the fundamental, fair-weather atmospheric electric phenomena noted above.

Further, since it is well known that the major phenomenon—the earth's potential gradient—varies according to *solar* diurnal time, all the other phenomena man be expected to vary likewise. It is, therefore, clear that the suggested new extra-terrestrial radiation, if it exists, should, directly or indirectly, have its origin on the sun.[11]

While work must first be done on an atmospheric molecule by a strong, applied electrostatic field component (to excite or modify the spectral radiation which it emits or absorbs), according to the electromagnetic theory it would also seem permissible to assume action by collision with particles of a proposed, new radiation of solar origin, in order to account fully for anomalies in the spectrum of the earth's lower atmosphere.

It is hoped to undertake a detailed mathematical analysis of this theory elsewhere, and I wish to express indebtedness to Professor N. R. Tawde for his encouragement and continued interest in this field of geophysics.

Department of Physics,
Royal Institute of Science, ALFRED B. ARLICK.
Mayo Road, Bombay,
*November* 20, 1947.

1. Arlick, A. B., *Curr. Sci.*, 1946, **9**, 105. 2. Frenkel, J., *J. Phys. U.S.S.R.*, 1944, **8**, 285. 3. Price, A. T. and Chapman, S., *Proc. Roy. Soc.*, 1928, **119 A**, 188. 4. Hogg, A. R., *Beitr. z. Geoph.*, 1935, **43**, 373 5. Forbush, S. E., *Terr. Mag.*, 1933, **38**, 4. 6. Medi, E, *Ricer. Sci.*, 1938, **2**, 139. 7. Arlick, A. B., *Sci. and Cult.*, 1939, **5**, 62. 8. Perot, A., *Compt. Rend.*, 1915, **160**, 549. 9. Nolan, P. J., and J. J., *Proc. Roy. Irish Acad.*, 1931, **60**, 30. 10. Schweidler, E., *SitzB. Akad. Wiss. Wien*, 1946, **149**, *2a*, 133-44. 11. Alven, H., *Phys. Rev.* 1947, **72**, 89.

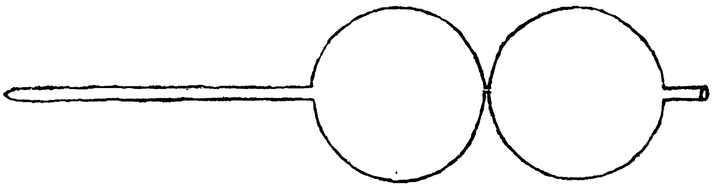
## A BULB-TUBE AS A PYKNOMETER

At times it becomes inconvenient to employ the usual type of pyknometer for the determination of specific gravity of liquids which are available in small quantities or when a liquid is either volatile or highly viscous. U-type pyknometers of small capacity may sometimes be helpful. But the removal of air bubbles and the cleaning of the apparatus require special care. Adjustment of the column of the liquid to the given mark at the suction-end involves special effort.

These difficulties are practically overcome if a bulb-tube, as represented below, is used.

The overall length of this bulb-tube may be 6 cm. the nozzle-end alone being 3 cm. The nozzle has a constriction at the end. The two similar spherical bulbs are each 1 cm. in diameter, and connected by a very short and fine capillary tube.

The liquid under investigation is sucked in *via* the nozzle up to the capillary connecting the bulbs.



While weighing in the balance, the bulb-tube may be rested in the pan horizontally on a suitable stool made of metal wire. It is found that the liquid does not flow into the second empty bulb—not at least during the few minutes required for the weighing. A volatile liquid like ether can also be weighed in this apparatus without any appreciable loss due to evaporation at room temperature (25–30° C.). This is further ensured if the suction end is plugged after the liquid has been sucked in. Cleaning does not present a problem even in the case of a highly viscous liquid.

By this method the S.G. for ether is 0·6540 and glycerine 1·2560 at 26°·2, which compares favourably with standard values.

Rajaram College,
Kolhapur, J. W. Airan.
*November* 5, 1947.

## THE 2:4 DINITRO-PHENYL HYDRAZINE COLOUR REACTION FOR VITAMIN K

Of the various colour reactions reported (reviewed by Reddy[1,2] for vitamin K, the 2:4-dinitro-phenyl-hydrazine colour reaction described by Novelle[3] was found to be the most useful because of the high sensitivity and stability of the colour developed. This reaction was found to be applicable to both fat-soluble and water-soluble vitamin K analogues that were available in the market. The following were the products examined:

| Trade name | Manufacturer | Chemical nature |
|---|---|---|
| 1 Kapilin (Injectule) | Glaxo Laboratories | 2-Methyl 1 : 4-naphthaquinone (in oil) |
| 2 Vitamindon K. (Tablets) | Indo-Pharma Pharmaceutical Works, Bombay | Methyl-naphthaquinone |
| 3 Synkamin (Injectule) | Parke Davis & Co. | 4-Amino-2-methyl-1-naphthol as hydrochloride (water-soluble) |
| 4 Synkavit (Injectule) | Hoffman La Roche | 2-Methyl-1 : 4-naphthohydroquinone diphosphoric ester as tetra-sodium salt (water-soluble) |

The green colour was obtained with all these above compounds and the colour was found to be proportional to the concentration of the quinone.

In adopting the technique of Novelle,[3] we experienced great difficulty during the addition of ammonia. Even the slightest excess of ammonia resulted in a reddish-yellow precipitate which masked the green colour. Further one cannot always be sure of the strength of the ammonia especially when the bottle has to be opened often. It was, therefore, considered necessary to study the reaction (especially the effect of pH) in detail and if possible to modify the method.

The green colour was obtained only when the final solution was definitely alkaline. At pH 6·8 a pale green colour was obtained with ammonia but the maximum intensity was obtained only beyond 7·3; but above 7·5 the use of ammonia resulted in a reddish-yellow precipitate. Various buffers and also NaOH in the place of ammonia were tried without success. Sodium carbonate, however, gave more satisfactory results. Even at high pH value $Na_2CO_3$ did not give rise to the reddish-yellow precipitate, and with this alkali the green colour was obtained only when the final solution was definitely alkaline to thymolphthalein. Further, the colour was quite stable even with excess of $Na_2CO_3$. Accordingly the following procedure was found to be satisfactory for the estimation of naphthaquinone derivatives, and hence vitamin K, using 2:4 dinitro-phenyl-hydrazine.

(i) *Procedure for fat-soluble naphthaquinone derivatives (Kapilin and Vitamindon K)*: 0·5 to 0·15 mgm. of the substance (usually in oil) was shaken up with 0·5 c.c. of ethyl alcohol and to this 0·1 c.c. of a 1 per cent. solution of 2:4-dinitrophenyl-hydrazine in 2 N hydrochloric acid was added. It was then heated in a water-bath at 70° C. for about 10 minutes. It was then cooled, and 0·3 c.c. of a 20 per cent.

solution of $Na_2CO_3$ was added with shaking followed by 1 c.c. of amyl alcohol and 1 c.c. of distilled water. The green colour separated in the amyl-alcohol layer and could be evaluated in a Lovibond Tintometer.

(*ii*) *Procedure for water-soluble derivatives (Synkamin and Synkanit)*: 0·5 to 0·15 mgm. of the substance dissolved in 0·5 c.c. of water was treated with 0·1 c.c. of the reagent and heated in a water-bath at 70° C. for about 3 minutes. It was next cooled and 0·3 c.c. of 20 per cent. sodium carbonate solution was added followed by 1 c.c. of amyl alcohol when the green colour separated in the amyl alcohol layer.

This reaction could be used to detect even 0·005 mgm. of the quinone, but a good working range for quantitative work would be 0·05 to 0·15 mgm. of the quinone..

Further work is in progress and a detailed report will be published elsewhere.

Department of Physiology, D. V. S. REDDY.
Madura Medical College, V. SRINIVASAN.
*December* 3, 1947.

1. Reddy, D. V. S., *Proc. Indian Sci. Cong.*, 1946, **87**. 2. —, *Medical Digest*, 1945, **13**, 239. 3. Noveile, *Sci.*, 1941, **93**, 358.

## INFLUENCE OF EXTRACTS OF GERMINATED INDIAN PULSES ON THE FORMATION OF AMYLASE BY *BACILLUS SUBTILIS*

RAGHAVENDRA RAO AND SREENIVASAYA[1] have shown the possibility of replacing the expensive asparagine, an ideal source of organic nitrogen for micro-organisms, by aqueous extracts of etiolated seedlings of certain Indian pulses that are rich in asparagine. The present work was carried out to determine the overall efficiency of these complex sources of nitrogen on the formations of amylase by *B. subtilis* (N.C.T.C.: 2027 N). The extracts were prepared at different periods of germination (4th, 6th and 8th day), and the results of their analysis were found to concur with those of previous workers.[1] These extracts have been tried,

TABLE I

*Effect of germinated pulse extract on production of Amylase by* B. subtilis *with extract containing 0·5 mg. nitrogen per 10 ml.*

| Days after commencement of germination | Enzyme Units per 10 ml. of medium | | | |
|---|---|---|---|---|
| | Green gram | Black gram | Bengal gram | Horse gram |
| 4 | 7·5 | 8·6 | 7·9 | 6·0 |
| 6 | 9·0 | 12·0 | 11·4 | 8·2 |
| 8 | 18·0 | 15·0 | 23·7 | 12·0 |
| With extract containing 1·0 mg. nitrogen per 10 ml. | | | | |
| 4 | 9·2 | 10·5 | 10·0 | 9·5 |
| 6 | 12·8 | 18·0 | 19·8 | 14·8 |
| 8 | 20·0 | 2'·6 | 30·0 | 22·2 |

by the method already described,[2] at two levels of nitrogen (0·5 and 1·0 mg. in 10 ml. of culture medium). The results are given in Table I.

The results show that, at both levels of nitrogen, the enzyme formed increases steadily with germination during the period of observation. The highest activity is obtained with the Bengal gram extract, both at 1·0 mg. and 0·5 mg. level of nitrogen.

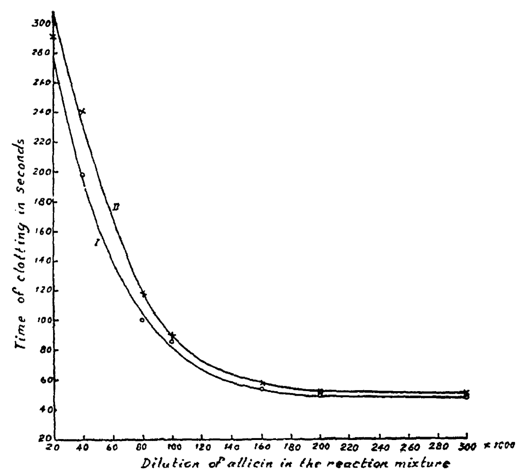
The author's thanks are due to Mr. M. Sreenivasaya and Prof. V. Subrahmanyan for their interest in this investigation.

Section of Fermentation Technology,
(later) Dept. of Biochemistry, B. S. LULLA.
Indian Institute of Science,
Bangalore,
*December* 12, 1947.

1. Raghavendra Rao and Sreenivasaya, *Curr. Sci.*, 1946, **15**, 25. 2. Lulla, B. S. (reference of the above paper), *Ibid.*, 1948, **17**, 2.

## EFFECT OF ANTIBIOTICS ON THE MILK-CLOTTING ENZYMES OF *CARICA PAPAYA* AND *FICUS CARICA*

SEVERAL instances of sulphydryl groups inactivating anti-microbial agents have been recorded in literature.[1-6] This has led to the view that the majority of the antibiotics act possibly by reacting with the -SH groupings of enzyme systems in the bacteria. Activation studies using glutathione, cysteine and other thiol compounds, and reversible inhibition by copper and maleic acid support the evidence in favour of the -SH nature of papain[7] and the milk-clotting enzyme of *Ficus carica*.[8] In view of this, it was of interest to study the effect of antibiotics on these enzyme systems.




Curve I after 5 minutes incubation
Curve II after 15 minutes incubation

Different dilutions each of penicillin and allicin were mixed with each enzyme (1:1 v/v),

incubated at 37° C. for different periods and the milk-clotting activities of the mixtures determined.[9] Typical results obtained with penicillin-papain system are presented in Table I.

TABLE I

*Inhibition of the milk-clotting activity of papain by Penicillin*

| Penicillin in O.U. per c.c. (cup plate method)* | Time in seconds for clotting after incubating the mixture for | | |
|---|---|---|---|
| | 15 minutes | 30 minutes | 60 minutes |
| Nil | 31 | 31 | 31 |
| 500 | 70 | 111 | 140 |
| 250 | 54 | 83 | 125 |
| 100 | 40 | 45 | 50 |
| 50 | 39 | 41 | 45 |
| 20 | 32 | 35 | 37 |
| 10 | 32 | 33 | 34 |

* The clotting times with the mixtures before incubation were found to be 31 seconds for all the mixtures studied.

Similar results were obtained for the Ficus enzyme-penicillin systems also.

Complete and instantaneous inactivation of the enzymes resulted on incubation with 0·2 mg./c.c. of allicin. When the concentration of the antibiotic was brought gradually to about 3·5 $\mu g$, results similar to those for penicillin were obtained. In the accompanying figure, results with allicin and Ficus enzyme are presented.

The above observations confirm the -SH nature of the enzymes studied. Attention has already been drawn to the inhibiting activity of allicin[10] on the starch-splitting activity of $\beta$-amylase, which has been shown to be another sulphydryl enzyme.[11] These observations are being extended to other enzyme systems known to play an important role in cell-metabolism.

It is clear that the enzyme-inhibiting activities of antibiotics like allicin even in very high dilutions provides a quick and accurate method for their micro-assay.

Our thanks are due to Prof. V. Subrahmanyan for his active interest in the above work. We acknowledge with gratitude the generous support from the Council of Scientific and Industrial Research, New Delhi.

R. RAGHUNANDANA RAO.
C. R. KRISHNA MURTI.

Dept. of Biochemistry,
Indian Institute of Science,
Bangalore,
*December* 4, 1947.

1. Cavallito and Bailey, *Sci.*, 1944, **100**, 300. 2. Eagle, *J. Pharm.*, **1939**, **66**, **436**. 3. Fildes, *Brit. J. Expt. Path.*, 1940, **21**, 67. 4. Atkinson and Stanley, *Australian Journal Expt. Biol and Med. Sc.*, 1943, **21**, **255**. 5. Geiger and Conn, *J. Amer. Chem. Soc.*. 1945, **67**, 112. 6. Cavallito *et al.*, *J. Bact.*, 1945, **50**, 61. 7. Ganapathi and Sastri, *Curr. Sci.*, 1940, **9**, 413. 8. Krishna Murti, C. R., *et al.*, *Sci. and Cult.* (under publication). 9. Balls and Hoover, *J. Biol. Chem.*, 1937, **121**, 737. 10. Rao, R R., *et al.*, *J. Sc. Ind. Res.*, 1946, **5B**, 31. 11. Weill, C. E., and Caldwell, M. L., *J Amer. Chem. Soc.*, 1945, **67**, 214.

## UTILIZATION OF DESIZING WASHINGS FOR THE CULTURE OF INDUSTRIALLY IMPORTANT MICRO-ORGANISMS

FOR desizing textiles, the common practice is to impregnate the sized cloth with an active amylase solution. After standing overnight the cloth is washed in running water. The washings contain about 1 per cent. sugar besides dextrins and other soluble matter. Our studies in the preparation of bacterial amylase show that the washings could be utilised as a source of carbon for the cultivation of the industrially important micro-organisms.

Bacteria (*B. subtilis*, N.C.T.C., 2027 N), Yeast (*Torula utilis*, N.C.T.C., 3050) and actinomyces (*Actinomyces gresius*, Waksman's strain), which had been previously standardized for amylase formation,[1] food yeast manufacture,[2] and streptomycin production,[3] respectively were employed as test organisms for determining the efficiency of these waste liquids. The cultural conditions for the growth of these organisms were the same, except that the carbon supply in the culture medium was substituted by the equivalent amount of the desized washings on the basis of sugar present. The viscosimetric method* was followed for determining the amylase activity. Yeast growth was observed by Turbidity measurements. The cup assay method, using a susceptible strain of *B. subtilis*, was employed for the assay of streptomycin. The comparative data obtained with the experimental and control media are given in Table I.

TABLE I

| *B. subtilis* | | Yeast growth | | *Actinomyces gresius* | |
|---|---|---|---|---|---|
| Amylase units per 10 ml.* of medium | | Galvanometric deflection | | Units $\gamma$/c.c. on 10th day | |
| *Exptl.* | *Contl.* | *Exptl.* | *Contl.* | *Exptl.* | *Contl.* |
| 100·0 | 120·0 | 200·0 | 176·0 | 100 $\gamma$ | 80 $\gamma$ |

* One Amylase unit is that quantity of enzyme which, acting on a two per cent. starch solution at pH 7·0 and at 40° C., reduces the viscosity by 25 per cent. in 90 minutes.

The results show that the desized waste is a useful source of assimilable form of carbon for the micro-organisms. The difficulty of transporting large volumes of the waste could be considerably reduced either by slightly modifying the process of washing of the desized cloth or by using the washings on the spot.

My sincere thanks are due to Prof. V. Subrahmanyan for his kind encouragement, and guidance in these observations, and to the late Mr. Slicer, Chief Chemist to Bangalore Wool-

len, Cotton and Silk Mills, Ltd., for supplying the desized washings.

Dept. of Biochemistry,
Indian Institute of Science,
Malleswaram P.O.,
Bangalore,
December 15, 1947.
B. S. LULLA.

1. Lulla, B. S., *Curr. Sci.*, 1947, **16**, 339. 2. D'Souza, V., and Sreenivasaya, M., *J. Sci. Ind. Res.*, 1946 **4**, 647. 3. Waksman, S. A., *J. Am. Pharm. Assn.* (Sci. Ed.), 1945, **34**, 273.

## CHANGE IN NITROGEN CONTENT OF MILK ON SOURING

IN this laboratory attempts were made to utilise the estimation of total nitrogen of curdled milk as a criterion of purity of the original milk samples by Kjeldahl Method as suggested by Hawley.[1] A preliminary analysis of about twenty samples on these lines showed that this method is unreliable, inasmuch as the nitrogen content of milk is subject to variation depending on the conditions under which the milk is allowed to curdle and on the initial bacterial flora of the sample.

The following table shows the increase of nitrogen on curdling, in the case of raw buffalo milk kept in different beakers and allowed to curdle in open air at room temperature (average 32° C.).

| Days of storage of milk | Acidity (lactic acid %) | Nitrogen (%) | Remarks |
|---|---|---|---|
| 0 | 0·126 | 0·533 | Raw milk before curdling |
| 1 | 0·815 | 0·641 | After curdling |
| 3 | 1·56 | 0·630 | ,, |
| 4 | 1·75 | 0·620 | ,, |
| 7 | 2·08 | 0·614 | ,, |

The main conclusions from experiments carried out under different conditions are:—

1. The nitrogen content of curdled milk is greater than that of the original milk.
2. The nitrogen percentage varies in the same sample of milk at different stages of souring; it attains a maximum and thereafter tends to decrease.
3. The acidity developed appears to bear little correlation with the nitrogen content.
4. The nitrogen increase appears to be caused by the action of micro-organisms present in the milk.

Since samples of milk are not collected and despatched under aseptic conditions, Hawley's method of evaluating the N. content of curdled milk, as a criterion for its purity, cannot be adopted for routine testing.

A detailed paper will be published elsewhere.

Laboratory of the Public Analyst
to the Government, U.P.,
Lucknow,
December 19, 1947.
S. C. ROY.
D. P. BHATNAGAR.

1. Hawley. *Curr. Sci.*, 1937, **5**, 637.

## GAMMEXANE (D. 025) AND CATTLE TICKS

A SMALL-SCALE trial with "Gammexane" powder D.025 has been tried on a group of fourteen cattle heavily infested with *Boophilus australis*, a common cattle tick in India. According to the manufacturers, "Gammexane" powder D.025 contains 5 per cent. of pure "Gammexane" (hexachlorocyclohexane) and 95 per cent. of inert diluent such as French chalk or talc. A dozen cattle showing gross infestation with ticks were hand-dressed with the powder. Two animals served as controls. Up to 12 hours after application there was no appreciable destruction of ticks. After nearly 24 hours tick mortality varied from 75-95 per cent. among the treated animals. After 48 hours all the treated animals were tick-free. The residual effect of the drug lasts from 5-9 days, depending on whether the treated animals are sent out for grazing or stall-fed. It is, therefore, necessary that the application should be repeated accordingly. In view of its efficient anti-tick and non-toxic properties and the simplicity of application, the powder could be safely used under Indian conditions.

Indian Veterinary Research Inst.,
Mukteswar-Kumaun,
December 1947.
B. N. SONI.

## OPTICALLY POSITIVE HYPERSTHENE FROM CHARNOCKITES OF GUNTUR DISTRICT

DURING the course of detailed optical work on the rocks and minerals of the charnockites of the Kondavidu Hills (Latitude 16° 15′ 30″; Longitude 80° 19′), one of the slides of the intermediate charnockites showed a hypersthene with abnormal optical characters. The scheme of pleochroism of this mineral as determined by the Federov's Stage is as follows:—

X: Golden yellowish green.
Y: Light greenish.
Z: Bluish or greyish green.

The only marked difference that this hypersthene shows with the normal type (the usual hypersthene met with in the area) is that the pleochroism along X axis is golden yellowish green here as against pale pink for the normal type.

In one of the hypersthene pieces the extinction is straight and 2 V = 74°, Z being the acute bisectrix. In the other the extinction angle (Z c) is 8° and 2 V = 69°, Z being the acute bisectrix. Thus both these pieces of hypersthene are optically positive. But the normal hypersthene shows the usual negative sign with 2 V ranging from 56° to 66°.

In the chemical analysis of the rock bearing this hypersthene, there is an excess of normative corundum. It is suggested, though it is not asserted, that this anomalous optical character of this hypersthene may be due to an aluminous variety of the mineral. Further work on the mineral is in progress, and a detailed paper will be published elsewhere.

Geology Department,
Andhra University,
Waltair,
December 23, 1947.
C. MAHADEVAN.
A. NARASINGARAO.

## THE SEX ORGANS OF *PHYTOPHTHORA HIMALAYENSIS* DASTUR

THE genus *Phytophthora* de Bary has been given, in spite of the unique mode of sexual reproduction in a section of its members—the amphygynous group—scant cytological attention in comparison with several other genera of the Peronosporales. The only thorough study of an amphigynous *Phytophthora* made so far is that of Murphy[1] on *P. erythroseptica* Pethyb. who advanced arguments to show that there is a piercing of the antheridium by an oogonial incept during copulation.

It has been claimed by some workers, however, that the amphigynous relation of the sex organs is an illusion resulting from an encircling of the female by the male gametangium, and that there is no actual penetration of the antheridium.

In an investigation into the morphology and cytology of development of the sex organs of a new species of *Phytophthora*, *P. himalayensis* Dastur,[2] I have observed that amphigyny, as the term is generally understood, is no artefact and that the oogonial incept does actually penetrate the antheridium.

Nuclear behaviour in *P. himalayensis* follows essentially the same sequence of events as that recorded by Murphy for *P. erythroseptica*. A stage in nuclear development, unique in the Oomycetæ and first described in *P. erythroseptica*, has also been observed in *P. himalayensis*. This particular stage of development has the basal region of the oogonial cytoplasm stratified in arcs of concentric circles whose centre lies somewhere in the oogonial stipe, while the cytoplasm at the distal (apical) region of the oogonium is non-stratified. The nuclei in the stratified region of the cytoplasm are linear or bow-shaped and oriented tangentially in relation to the stratifications, and occur in invariable association with the latter. The nuclei at the distal, non-stratified region are spherical like the nuclei at all other stages of development of the sex organs (Fig. 1).

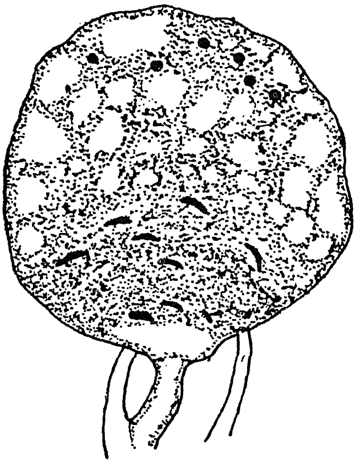


FIG. 1

Murphy regarded the elongate nuclei as eventually transforming into the spherical. In my opinion, the linear form of the oogonial nuclei is due to the pressure exerted on them owing to their characteristic association with cytoplasmic strata which result from regular differences in density of the proximal oogonial cytoplasm.

A curious feature in the morphology of *P. himalayensis* is the development of short, tubular protrusions from antheridia.

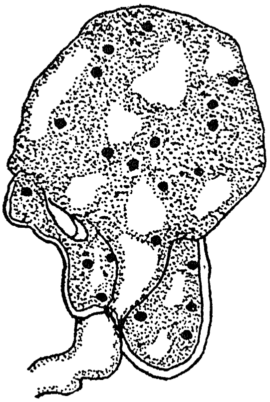


FIG. 2

These antheridial papillæ have not been observed in all copulating gametangia. Each antheridium, in which such papillæ have been observed, generally puts out one protrusion, rarely two or three at a time. Similar papillæ, also observed in *P. erythroseptica* by Murphy were believed by him to function in easing the pressure developed within the antheridium as a result of penetration of the latter by an oogonial incept. My observations do not bear out the function ascribed to them by Murphy. Rather, they serve as fertilization tubes much as the antheridia of paragynous Phytophthoras; owing to the origin of such papillæ from amphigynous antheridia and their homology with paragynous antheridia, such a type of gametangial copulation demonstrates the fundamental similarity of paragyny and amphigyny.

A detailed discussion of the ontogeny of the sex organs of *P. himalayensis* will be published later.

I am grateful to Prof. J. F. Dastur for help in the preparation of this note.

Indian Agric. Res. Institute,
New Delhi, BALAJI D. MUNDKUR.
*September* 1, 1947.

1. Murphy, P. A., *Ann. Bot.*, 1918, **32**. 2. Dastur, J. F. (in press).

## A XENOSTELE ON *NEOLITSEA ZEYLANICA*

COLLECTIONS of rusted branches and leaves of *Neolitsea zeylanica* Merr. were collected from near Ootacamund, South India. Field observations indicated that the rust had broken out in an epiphytotic form. A detailed examination revealed that the rust is a species of *Xeno-*

*stele* Syd. and agreed in all features with *X. neolitseæ* Ramak. and Ramak., described recently by Ramakrishnan and Ramakrishnan[1] on the same host species from the same locality. The rust forms conspicuous galls on the leaves and young twigs. Only telia were noticed for the rust. Most of the morphological details have been given by the above authors. It might be mentioned that the teliospores are pedicellate, developing in clusters.

Ramakrishnan and Ramakrishnan state, "two species of this genus have been recorded—*X. echinacea* (Berk.) Syd. on *Actinodaphne molochina* in Ceylon, and *X. litseæ* (Pat.) Syd. on *Litsea glauca* in Japan". They were evidently unaware of the fact that *X. Neolitseæ* Teng was described by Teng[2] on *Neolitsea* and that Hiratsuka and Yoshinaga[3] reported *X. nakanoi* (Kusano and Yoshinaga) Hiratsuka and Yoshinaga on three Lauraceous hosts including *Neolitsea aciculata*. The latter is an opsis rust with peridiate æcia and telia.

Only telia are known for *X. neolitseæ* Teng., where the sori are 144-180 $\mu$ broad as against 350-400 $\mu$ of the present rust. The teliospores are slightly shorter and broader in the Indian species (40-55 $\times$ 24-30 $\mu$ as against 45-65 $\times$ 19-24 $\mu$ in *X. neolitseæ* Teng.). The comparatively large telia taken along with the slight differences in the sizes of the teliospores in the Xenostele species under study might be used to separate it from *X. neolitseæ* Teng. Since the specific epithet, *Neolitseæ*, has been used by Teng for a rust distinctly separate from the one under study, the name *Xenostele indica* Thirumalachar nom. nov. is proposed for the Indian species.

Dept. of Plant Pathology,
University of Wisconsin,
Madison, Wis., M. J. THIRUMALACHAR.
*November* 30, 1947.

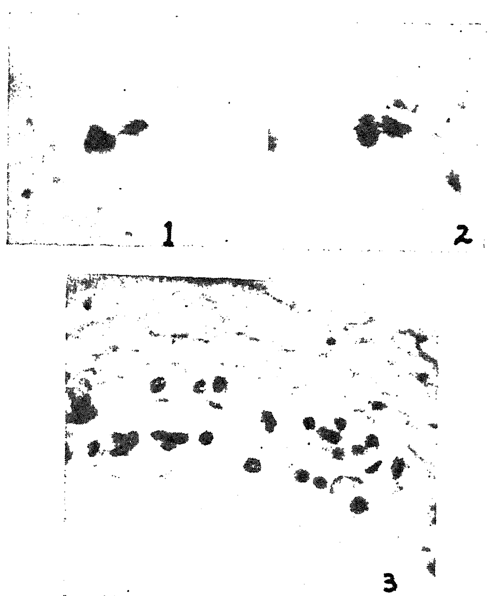
1. Ramakrishnan, T. S., and Ramakrishnan, K., *Proc. Ind. Acad. Sci.*, 1947, **25**, 28. 2. Teng, S. C., *Sinensia*, 1940, **2**, 105. 3. Hiratsuka, N., and Yoshinaga, *Mem. Tottari Agr. Coll.*, 1935, No. **2**, 284.

## A CASE OF CYTOMIXIS IN *CROTALARIA MEDICAGINEA* LAMK.

THE chromosome number of *Crotalaria medicaginea* Lamk. only has been reported by Sundar Rao,[1] as $2n = 16$. For further details, a cytological study of *C. medicaginea* has been undertaken.

In some root tips, with periblem cells 2-3 thick, situated 3 or 4 layers below the dermatogen remain more deeply stained even after prolonged destaining. In such cells the chromatin material has migrated into the adjacent cells through protoplasmic connections (Figs. 1, 2) resulting in uninucleate cells (Fig. 3). The migrated chromatin material is more deeply stained than the rest of the cell. Cytomixis,[2] as it is termed, is not peculiar to any particular stage, but is reported to occur in all stages of division of p.m.c., *viz.*, in interkinesis[3] both divisions,[4] and in the resting stage.[5] In root tips, however, only two cases have been reported so far by Jacob in *Clitoria ternata*[6] and in cotton.[7]

Gates[2] considers that the conspicuous openings or connections between p.m.c., allow an equalisation of pressure in the mother-cells




FIGS. 1–2. Extrusion of chromatin material.
1. Through one protoplasmic connection, 2. two connections.
FIG. 3. Multinucleate cells in periblem region, a result of cytomixis.

from one end of the anther to the other. The movement of the nuclei towards the periphery and the nuclear extrusion are believed to occur in connection with this pressure-equalisation. This process is observed more frequently in the chloralised cells than in the normal p.m.c. of *Vicia faba*.[8] Cytomixis is reported to result in abnormalities like increased chromosome number, as in rice[9] and in disintegration of *Triticum* and *Aegilops*,[10] and disintegration of cells.

Though the continuity of affected cells as a ring in the root tip of *C. medicaginea* supports the idea of pressure-equalisation, this 'pressure' seems to arise as an abnormality, as is evidenced by the presence of isolated single or groups of cells in the plerome. In this case cytomixis appears to be pathological, leading to disintegration of cells.

The chromosome number is also determined in mitosis and meiosis and is found to be 16 and 8 respectively as reported previously.[1]

I am thankful to Prof. N. K. Tiwari for his helpful suggestions in preparing this note.

Pithapuram, N. SATYANARAYANA RAO.
*December* 6, 1947.

1. Sundar Rao, Y., *Indian J. Genet. and Pl. Breeding*, 1943, **3**, 64. 2. Gates, R. R., *Ann. Bot.*, 1911, **25**, 909. 3. Gates, R. R., and Rees, E. M., *Ibid.*, 1921, **35**, 365. 4. Iyengar, N. K., *Ibid.*, 1939, **3**, 275. 5. Mensinka, S. W., *J. Genet.*, 1940, **39**, 1. 6. Jacob, K. T., *Ann. Bot.*, 1940, **4**, 201. 7. —, *Curr. Sci.*, 1941, **10**, 174. 8. Sakamura, T., *J. College. Sci. Imp. Univ.*, Tokyo, 1920, **33**, 1. 9. Nandi, H. K., *J. Genet.*, 1936, **33**, 315. 10. Kihara, H., and Lilienfield, F., *Jap. J. Genet.*, 1934, **10**, 1.

## ON GOURAMI NESTS IN A HILL SPRING AND A ROCKY GUNDAM

WITH the scanty rainfall and sparsely scattered waters, acquiculture in the Ceded Districts has to be confined to a limited number of suitable waters. The Nalla malai area in Kurnool is dotted with many natural springs and rocky tanks. Attempts at Gourami culture in such waters were successful, and some interesting observations could be made on gourami nests in a typical hill-spring and a rocky "gundam".

The Chagalamarri spring off Nandyal-Cuddapah road was stocked with half a dozen one-foot gourami in November 1944, and *Chara* and Bulrush were planted in the centre and along the margins respectively. In June 1945 two nests were observed in a quiet corner, away from the springs and the main flow. The location of the nest outside the action of the current is not perhaps accidental.

The "Kamini gundam" at Panyam is a fairly large tank. The "gundam" was devoid of macrophytic growth, specially after de-weeding. Even the margin was bare except for some short grass. Yet, on 10th of March 1946, a big-sized nest, made up of neem and bombax leaves, with gourami eggs was seen drifting on the surface. Careful observation revealed that the parents closely followed the nest as it drifted from place to place. After about ten days healthy hatchlings were seen moving about. It was thus seen that though the nest got freed and drifted about, the gourami kept on the parental care and the drifting condition of the nest did not interfere with the incubation of the eggs.

My thanks are due to the Director of Industries and Commerce, Madras, for kindly permitting this note to be published and to Dr. T. J. Job for helpful suggestions in preparing this note.

Pearl and Chank Fisheries,
Tuticorin,
*August* 30, 1947.
V. D. SPURGEON.

## YOUNG'S MODULUS

MR. V. L. TALEKAR has described[1] a method for determining Young's modulus for materials.

He has pointed out that so far only mechanical methods have been used for this purpose, and claims that his method of determining Y by electromagnetic and interferrometric measurements would be simpler in comparison with the traditional method.

This seems hardly plausible since his method involves measurements of electric currents, magnetic fields and small distances with the help of interferrometer, in addition to the usual measurements of length and diameter of the specimen.

He has also neglected the geometrical properties of the metallic ring to be tested as well as the effect of heating by electric current on the elasticity of the specimen.

In short, it is doubtful if the novelty alone can in any way recommend the adoption of his method in preference to the traditional one.

7-A, Vissonji Park,
Naigaum Cross Road,
Dadar, Bombay 14,
*December* 29, 1947.
S. C. OAK.

1. Talekar, V. L., *Curr. Sci.*, 1947, **16**, 337.

THE idea in giving this method is not to replace the traditional one as Mr. Oak has mentioned; but to provide an additional one. It is easy to see that due to very low resistances of metals and the small size of the ring, there will be hardiy any heating of the specimen. The quantities involved can easily be measured in a scale suitably equipped and should not present any difficulty as envisaged by Mr. Oak. The method is being worked by the author.

Dungar College,
Bikaner,
*January* 14, 1948.
V. L. TALEKAR.

## NEW THEORY OF SMELL

WAVES comparable to those of light and radio but carrying smells are the essence of a new theory of the olfactory mechanism, developed and tested experimentally by scientists of Yale University, New Haven, Connecticut. The theory relates the sense of smelling to that of light rather than to chemical processes which were formerly believed to be responsible for the faculty of smelling.

The new theory endows the nose with remarkable and strange facilities, operating on a principle resembling the emission and echo reflection that make radar a miraculous detection instrument. According to the theory, the human nose is but a house for a set of antennæ —the tiny hairs in the nasal cavity just behind the point where eyebrows and the nose-bridge meet. This olfactory organ sends out an array of wavelengths, all within an octave in the infra-red range of the spectrum, rich in radiation from complex chemical substances.

In the nose's particular waveband, called the *osmic range*, tiny wave-beams are sent out to each substance to be smelled. Some of the beams will be absorbed, but others will be reflected, depending on the molecular structure of the substance. This reflected infra-red radiation returns to the nose. There this 'echo' finds a dense mass of nerve endings in the dark parts of the nasal membrane, rivalling in complexity and sensitivity the retina of the eye. These nerves are the receivers of smell, placed under protection so that an abundance of smells would not become confusing.

Under the new theory, smelling is an energy-resonance phenomenon which gives the nose the new name of osmic-radiation receiver. The transmitter-receiver combination locked in the nose operates on wavelengths ranging between 80,000 and 140,000 Angstrom units, compared to 4,000 (violet) to 8,000 (red) units for visible light.

The theory came into being through experiments with insects such as roaches and bees which smell with their feelers. Most startling was the experiment with a rare species of moths. Marked males were released from a train each mile up to seven miles distance. A few hours later the males had found their way back to a female, kept in an hermetically closed glass tube at the point of the train's departure.—*USIS*.

# REVIEWS

**Qualitative Analysis by Spot Tests—Inorganic and Organic Applications.** By Fritz Fiegl. Third, completely revised English edition, translated by Ralph E. Oesper. (Elsevier Publishing Co., Inc., New York, Amsterdam), 1946. Pp. 574 + xvi. Price $8.00.

The first English edition of the book appeared in 1937 and the second in 1939, the latter translated from the third German edition. Several reprints of the second translated edition were issued. Now, with the return of peace, the third edition—the one under review—has been brought out. The frequency with which several editions of a book and numerous impressions of the same edition appear, undoubtedly speaks of the demand for the popularity of the book.

Analytical chemistry is an unobtrusive branch of chemistry with few flowers and hardly any fruit. It attracts few votaries, as its pursuit seldom yields spectacular results. Yet those ardent few who more than nibble at this branch sometimes lay foundations in chemistry as firm and permanent as those others who gave it its laws. That is what is exceptionally revealed by a study of the 'art' which Feigl has almost made his own and made known through the pages of his book.

In a book of practical nature where nothing can be irrelevant nor redundant, the summary of its contents is best given by quoting relevant portions from the author's preface. Here it is. "The present edition includes the newer spot reactions, together with details of the pertinent procedure and applicatinos. ... The author has tried to assemble and present the entire literature on spot test analysis in such form that the reader will be able to secure here a rapid survey of the available spot tests and their applications. Tested directions for carrying out the tests are of course an integral part of the text."

Among the several other features is a new chapter: "Working methods and special aids" included to give a complete picture of all the phases of spot test analysis.

Further appraiement of the book leads to commenting on the general methods of spot test analysis itself. The new scheme of analysis could not be said to be yet as perfect as the classical methods of qualitative analysis, inorganic or organic. Because the classical analysis is systematised and rather simple, it is usually easy to get familiar with its methods. But it is quite different with the tests prescribed in the book. Each of these tests is so specific for a particular radicle or group that in its application one must have a prior knowledge, at least approximate, of the constituents of test mixture. Chapter V provides but a partial remedy to this. The science is comparatively recent, and it is as yet too early to say whether these new methods of analysis would supplant, if even, the classical systematic methods of qualitative analysis. Even in its present limited role of being a supplement to the classical methods, the 'spot' test is already proving to be a very potent weapon in the armory of the analytical chemist. But the technique is very special; and only those versed in it can wield it, and the book helps one in this respect.

S. N.

**Trace Elements in Plants and Animals.** By W. Stiles, Mason Professor of Botany in the University of Birmingham. (The Cambridge University Press), 1946. Pp. xii + 189. Price 12*sh.* 6*d.*

Although Mazé gave a fillip to the trace element problem as early as 1914, through demonstrating the sources of errors inherent in the experiments and suggesting precautionary measures, the work did not proceed far, as no sensitive methods of estimation of "traces" were then available. It is only during the last decade that the problem has progressed by leaps and bounds with the development of physical instruments, such as the absorptiometer, the polarograph, and the spectrograph, and chemical techniques such as the Dithiozone method. Since the discovery of their importance in the so-called physiological diseases, the trace elements have engaged the interest of not only the plant physiologist but also the plant pathologist, the veterinary surgeon, the agriculturist and the horticulturist. In fact the work done in recent years is so bewilderingly enormous that a masterly résumé on the subject has been very much needed. In bringing forth the book, therefore, Professor Stiles is catering for the earnest demands of both the erudite and the beginner.

After a brief historical introduction, the author proceeds to discuss at length the methods of purification of materials and estimation of micronutrients and the diagnosis of deficiencies are very informative to the investigator. A full chapter is set apart for the diseases of various economically important plants caused by the deficiencies of Mn, Zn, B, Cu and Mo. The difficulties encountered in diagnosis and treatment are well discussed. The chapter on the function of trace elements in plants critically reviews the entire work done in this field. The comparatively meagre progress achieved in the case of animals is dealt with in a separate chapter. The function of trace elements in general in the metabolism of animals are still obscure and the discovery that Cu and Zn are associated with proteins and enzymes as prosthetic groups may help to throw light on the role of other elements also.

The book, giving all the available facts and outlining ways for future research, will be very useful to one and all interested in the subject. S. R. ASWATHA NARAYANA RAO.

**An Introduction to Textile Finishing.** By J. T. Marsh. (Chapman and Hall, London). Pp. 552. Price 35*sh.* net.

Finishing of textile goods has been in the vanguard of post-war developments in Textile Technology as revealed by the numerous processes and patents recorded in current technical literature, and Mr. Marsh set himself a

formidable task in attempting "to survey finishing as a whole" (p. 393), but has successfully accomplished it in this publication. He has rendered signal service to the science and practice of textile finishing by bringing under one cover the widely scattered literature on the subject, including his own valuable contribution. The book running to XXI chapters covering 535 pages is indeed much more than an introduction—it is a veritable compendium or digest with a wealth of information embracing a variety of finishes, both traditional and modern, applicable principally to cotton, wool, silk and rayon, the chemical and physico-chemical methods being dealt with in greater detail than the purely mechanical finishes.

The general nature of the finishes applied to woven and knitted fabrics of various raw materials is covered by the Introductory chapter, while the finishing machines and mechanical finishes are completed in the Second, and crepe finishes in the Third. The next two chapters deal with the dispersion processes like mercerising, and the applications of Formal-dehyde. Three chapters thereafter are devoted to the various finishes for woollen goods like permanent setting, milling and non-felting, the latest developments being referred to. The next three chapters deal with the very useful anti-shrink processes for cotton, softening and starch finishes. The discounted practice of weighting, and delustering, chiefly applicable to rayon claim a chapter each. The chapter on cellulose derivatives explains the interesting process of coating fabrics with cellulose ethers and esters. The next two chapters deal with the remarkable modern finishes, the application, both external and internal (thermo-plastic and thermo-setting) or synthetic resins, particularly urea-formaldehyde and their effect on fabric properties. The application of latex and synthetic rubber is covered by the next chapter. The last four chapters deal with the principal utility finishes, much perfected by the Quartermaster-General Corps, like water-proofing, moth-proofing, mildew-proofing and fire-proofing for which legislation is contemplated in the United States of America. The book ends with an excellent bibliography and a name and a subject index.

The exposition which is clear, concise and direct is mainly practical with a commendable restraint on mere theoretical intricacies. The author has drawn freely on the published patent and current technical literature, which makes the book at once authoritative and informative, references to English Journals being more frequent than to Amrican or German Journals. The author has done well in citing references to original literature in the text itself. The book is fully illustrated, particularly the earlier section, with a number of helpful photographs, line diagrams, tables of results and graphical representations.

The book is neatly printed and elegantly got up. Except for a few minor 'devils' like "ofl oose" for "of loose" (p. 345), "methylenure as" for "methylene ureas" (p. 397), "So° C" (p. 401), it is remarkably free from printing mistakes. The letter 'I' in the diagram on p. 245 is obscured.

While it is not clear why the author sometimes prefers the obsolete "artificial silk" to the modern "rayon", or "native" to "natural" cellulose or fibres, many would hesitate to accept his verdict that "textile English is not noted for its elegance" (p. 260). To a votary of science, the apology, "these tests and other methods of control, still form a valuable commercial asset *and cannot* be disclosed as yet" (p. 400), comes as a shocking anticlimax in a book written but to disclose.

Comprehensive as the volume undoubtedly is, a few items like use of tamarind size, test methods for evaluation of finishes on fabrics with test results and a few more nylon finishes would be welcome additions.

Aptly dedicated to the memory of John Mercer, the pioneer in textile finishing, this indeed is an up-to-date volume which every textile technologist should possess and could consult with great profit, useful alike to the teacher and the student, the mill supervisor and the research worker.

S. N. B.

**Poisons.** *Their Isolation and Identification.* By F. Bamford. Revised by C. P. Stewart. (J. & A. Churchill, London), 1947. Pp. 304. Price 21*sh*.

This book on Poisons was reviewed in 1940 when it made its debut as a first edition. There have not been many changes since then. It is to be regretted that though it has been written by an author who has worked in Egypt, it cannot be used extensively in India where the poisons and alkaloids used are not the ones which are emphasised in his book. That Poropyroxine colour reaction is not specific for Indian opium, has been drawn attention to, and it may be stated that given a sample of pure opium it would be impossible to dogmatise on its origin, *i.e.*, whether it is Levantine, Turkish or Indian. It is rather unfortunate that the very fashionable Barbiturates have been discussed within two pages. A good index is appended. The book costs a Guinea—rather expensive from the Indian point of view.

C. V. NATARAJAN.

**Elementary Analytical Chemistry.** By Lyons and Appleyard. 14th Edition. (Churchill Ltd., London), 1947. Pp. 279. Price 9*sh*.

The volume under review is a classical textbook of qualitative and quantitative analysis that has served students of chemistry for generations in their preliminary university courses. In India the book is useful for Intermediate and Pass-course B.Sc. candidates. This edition, coming after the 1938 edition, has been thoroughly revised and brought up to date. A number of additional qualitative tests for the metals have been added, and the section on volumetric analysis has been extended by the inclusion of further exercises, including the use of potassium iodate and bromine as reagents. The usefulness of the volume could perhaps have been very much enhanced if a simple introduction to colorimetric methods of analysis had also been included. This section would be very welcome to students of general degree examinations, from whose ranks many a laboratory assistant and industrial analyst is drawn.

K. S. R.

# SCIENCE NOTES AND NEWS

## Scientific Research Association

Pandit Jawaharlal Nehru, the Prime Minister, was elected President of the Association of Scientific Research for the year 1948 at the annual meeting of the Association held at Patna.

According to the draft constitution of the Association, it will henceforward be run on Trade Union lines. The constitution also restricts the membership of the Association to Science Graduates and professionally competent scientific workers.

## Science Congress Association

Sir K. S. Krishnan, Director of the National Physical Laboratory of the Government of India, and Dr. B. Mukherji, Director, Central Drugs Laboratory, Government of India, were elected President and General Secretary respectively of the Indian Science Congress Association for the year 1948-49 at the annual meeting of the Central Committee of the Association.

The following were elected members of the General Council of the Association: Dr. B. Mukherji, Dr. B. C. Guha, Dr. W. D. West, Dr. K. N. Bagchi, Dr. K. Venkataraman, Dr. A. C. Ukil, Dr. B. Sanjiva Rao, Dr. K. N. Bahl, Dr. U. P. Basu, Dr. Baini Prasad and Prof. G. P. Mazumdar.

The following were elected Presidents and Recorders respectively of the twelve Sections of the Association :—

*Mathematics*: Dr. S. Chowla and Dr. P. N. Das Gupta.

*Statistics*: Dr. V. S. Nair and Mr. S. Sen Gupta.

*Physics*: Dr. R. S. Krishnan and Dr. P. S. Gill.

*Geology and Geography*: Dr. C. Mahadevan and Dr. S. C. Chatterji.

*Anthropology and Archæology*: Dr. Nirmal Kumar Bose and Dr. M. N. Basu.

*Medical and Veterinary*: Dr. M. B. Soparkar and Dr. H. N. Ray.

*Agricultural Sciences*: Dr. R. S. Vasudeva and Mr. P. C. Raheja.

*Physiology*: Dr. B. B. Sarkar and Dr. N. P. Banawasi.

*Engineering and Metallurgy*: Prof. M. Sen Gupta and Prof. J. Ganguli.

*Chemistry*: Dr. P. B. Ganguli and Dr. D. Chakravarti.

*Entomology and Zoology*: Dr. M. L. Roonwal and Dr. H. D. Srivastava.

*Botany*: Mr. M. S. Randhawa and Dr. R. L. Nirula.

*Psychology and Education*: Mr. T. K. N. Menon and Mr. Kali Prosad.

## Industrial Research Council

With effect from January 1, 1948, the Governing Body of the Council of Scientific and Industrial Research and the Board of Scientific and Industrial Research have been reconstituted as under for the period ending March 31, 1950:

1. *Governing Body of the Council of Scientific and Industrial Research*: Pandit Jawaharlal Nehru (*President*); Dr. Shyama Prasad Mookherjee (*Vice-President*); Mr. S. A. Venkataraman (*Ministry of Industry and Supply*); Mr. P. C. Bhattacharya (*Ministry of Finance*); Prof. M. N. Saha, Sir J. C. Ghosh, Sir S. S. Bhatnagar, Sir Sri Ram, Prof. S. N. Bose, Mr. G. L. Mehta, Mr. Kasturbhai Lalbhai, Sir A. L. Mudaliar, Dr. S. S. Joshi, Mr. Frank Anthony, Sir V. N. Chandavarkar, Mr. H. Sitarama Reddi, Dr. K. Hamid, Mr. G. D. Birla, Mr. N. V. Gadgil, Principal Niranuan Singh, Sir Ardeshir Dalal and Mr. J. R. D. Tata.

2. *Board of Scientific and Industrial Research*: Pandit Jawaharlal Nehru (*President*); Dr. Shyama Prasad Mookherjee (*Vice-President*); Mr. S. A. Venkataraman, Dr. B. C. Roy, Sir S. S. Bhatnagar, Sir K. S. Krishnan, Dr. Jivraj Mehta, Dr. K. L. Moudgill, Sir Abdul Halim Ghuznabi, Sir J. C. Ghosh, Prof. M. S. Thacker, Prof. Birbal Sahni, Mr. Kasturbhai Lalbhai, Prof. M. N. Saha, Sir Shri Ram, Dr. K. A. Hamid, Sir Ardeshir Dalal, Dr. H. J. Bhabha, the Scientific Adviser to G.H.Q., Sir C. V. Raman, Mr. D. N. Wadia and Dr. J. N. Mukherjee.

## Commonwealth Collection of Type Cultures

The Hon'ble Vice-President, Council of Scientific and Industrial Research and Scientific Consultative Committee, Governmnt of India, has nominated Mr. M. Sreenivasaya, Lecturer in Fermentation Technology, Indian Institute of Science, Bangalore, as a member of the Permanent Committee of the Commonwealth Collection of Type Cultures in London.

## Bose Institute

The Bose Institute, Calcutta, celebrated the 30th Anniversary of the Foundation of the Institute on the 30th November 1947 under the presidency of H. E. Sri. C. Rajagopalachari, Governor, West Bengal. Dr. J. N. Mukherjee, Director, Indian Research Institute, Delhi, delivered the Jagadish Chandra Memorial Lecture on "Some Scientific and Practical Problems of Agriculture in India".

## Central Institute of Education

On Friday, the 19th December 1947, the Central Institute of Education was opened in Delhi by H. E. the Countess Mountbatten of Burma. A grant of Rs. 18 lakhs and about Rs. 2·5 lakhs for equipment have been sanctioned towards this project. This has been instituted in accordance with the plan of the Government of India to provide "Model Teachers" for the various provinces and states in the country.

## The Indian Dairy Science Association

The "Indian Dairy Science Association" has been founded at Bangalore. A meeting of the Executive Committee was held at New Delhi on the 16th December with Sir Datar Singh in the Chair. It was decided to open the membership of the Association to all persons engaged in teaching, research and advisory work in dairying, or holding technical positions in the field of dairying. The Association's aim is to

publish a Journal devoted to Dairy Science and fill up a long-felt want in this direction.

The headquarters of the Association is located at the Indian Dairy Research Institute, Bangalore. Members who wish to join the Association may communicate with the Joint-Secretary of the Association.

## Soil Research Station in Madras

Mr. N. V. Gadgil, Minister for Works, Mines and Power, Government of India, opened in Madras the Concrete Laboratory and the Soil Engineering Research Station built in connection with the Ramapadasagar Dam on 19th December 1947.

## Conference on Compost

On the initiative of Shrimati Mira Behn a Conference of workers and others interested in the Compost Programme was held in the Secretariat Buildings, New Delhi, on the 16th and 17th of December 1947. The Conference was opened by the Hon. Dr. Rajendra Prasad.

The Conference resolved that a systematic utilisation of urban and village wastes would yield about 110 million tons extra manure, while a programme for providing alternative fuel in place of cow dung would release another 200 million tons of manure, which would increase our food production by about 12-15 million tons and at the same time provide additional fodder.

Resolutions were also passed suggesting methods of implementation of schemes for countrywide production and utilisation of compost.

## Research Scholarship

One Science Research Scholarship will be awarded this year by the London Exhibition of 1851 to students from Indian Universities or institutions having post-graduate departments of Science. The scholarship, which is of the value of £350 per annum and tenable for a period of two years, is intended to enable the selected student, who has already completed a full University course and whose record gives evidence of capacity for original scientific investigation, to devote himself to post-graduate research in some branch of pure or applied science at any institution abroad approved by the Commissioners.

Subjects of the Dominion of India and Indian States, below the age of 26 years on May 1, 1948, will be eligible for this scholarship. Applications from students, whether residing in India or abroad, have to be recommended by the authorities of a University or an institution and are to be made to Provincial Governments and Local Administrations through the Universities and institutions concerned, who would forward them so as to reach the Secretary, Ministry of Education, Government of India, not later than 10th March 1948.

## Scholarship in Minerolagy

Dr. Ben H. Parker, President of the Colarado School of Mines, U.S.A., has announced that a scholarship at the School of Mines will be awarded annually, beginning with the school year 1948-49, to a resident of India upon the recommendation of the Minister of Education.

The scholarship meets all tuition expenses (now \$425 a year), and is renewable for a maximum of 4 years provided the student maintains satisfactory record. Deposits, special student fees, summer session tuition and living and other personal expenses are not included.

The Colorado School of Mines trains students in mining, metallurgy, geology, petroleum production and petroleum refining with options in fuel engineering and geophysics, and elective courses in the production and utilisation of cements, refractories, clays, and other non-metallic minerals.

The Minister of Education's recommendation must reach the office of the President of the School by June 15, 1948. Further particulars may be obtained from the United States Foreign Embassy.

## Lady Tata Memorial Trust

The Trustees of the Lady Tata Memorial Trust are offering six scholarships of Rs. 250 each per month for the year 1948-49 commencing from 1st July 1948. Applicants must be of Indian nationality and Graduates in Medicine or Science of a recognised University. The scholarships are tenable in India only, and the holders must undertake to work whole-time under the direction of the head of a recognised Research Institute or Laboratory. The subject of scientific investigation must have a bearing either directly or indirectly on the alleviation of human suffering from disease. Applications should reach by March 15, 1948. Further particulars may be had from the Secretary of the Trust, Bombay House, Bruce Street, Fort, Bombay 1.

## Lord Rayleigh OBITUARY

Lord Rayleigh, the distinguished physicist, passed away on December 13.

Born in 1875, he studied at Eton and Cambridge, from where he passed out with First Class Tripos in Natural Science. After working for a number of years at the Cavendish Laboratory, he became Professor of Physics at the Imperial College of Science.

Lord Rayleigh was interested in a wide range of subjects, including agriculture and dairy farming. He was more of a skilled experimentalist than a theoretician, and studied common phenomena like the evening sunlight and the shapes of stones. He was elected an F.R.S. and also to the Presidentship of the British Association, two honours which incidentally, his father had also received.

## Srish Kumar Sen

We regret to record the death of Srish Kumar Sen, a noted systematic Botanist and a retired Government servant of Bengal, on October 9, 1947. An active member of the Dacca Botanical Society and an organiser of the University Botanical Gardens and Herbarium at Dacca, Sen was responsible for bringing into light many new species of plants of Bengal. Sen was also a great patriot who had been charged in the famous Arabindo case of 1908. His loss is deeply regretted by all his friends and admirers, who are many.

62-48 Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore

Current Science

Vol. XVII] FEBRUARY 1948 [No. 2



# MAHATMA GANDHI

AT rare intervals in the history of mankind, there arise personalities, the wide response to whose teachings inspire the hope that man, after all, is progressing in the right direction. The traits of these great personalities are easily described. They embody in themselves and typify all the lofty ideals of social conduct which civilised man cherishes at heart but often fails to adopt in the normal activities of life. These great men are optimists having intense faith in the essential goodness of man, in his sweet reasonableness and in his eventual conversion, by precept and example, to a life of charitable neighbourliness. They leave the impress of their teachings and of their model lives, not merely on their own age but on generations to come. Such was the life of Mahatma Gandhi, and there is little doubt that he will be ranked among the great teachers of the world.

That Gandhi fell at the hands of a misguided youth, moved by narrow sectarianism, is, indeed, no reflection on our civilisation, our land or our high religious convictions. For, in every land and every age, people in all grades of moral evolution are to be found. Their individual conduct cannot be generalised sweepingly as of the generation or of the country. During Lincoln's lifetime there must have been as few men of his calibre as of Booth, his assassin. The world reaction to Mahatma Gandhi's unnatural end makes us believe that his martyrdom, even as that of Jesus Christ, will assure a lasting response to his ideal of *ahimsa*. And the universal veneration which he commanded in his lifetime is further proof that his teachings will not be forgotten after his death.

In every role—as reformer, statesman, ascetic and religious preacher—Gandhi was

truly a revolutionary. Like all great revolutioanries, he was a man of paradoxes: it was difficult to classify his views along accepted lines. He claimed to be a sanatanist, but advocated the equality of all castes; he was a lucid thinker, but an unhesitating dualist in theology; he dedicated his life to the economic and social upliftment of the masses, but unflinchingly advocated atavism in many fields of human endeavour; and finally, though the most doughty champion of the oppressed and the enslaved, he would have nothing to do with violent methods of emancipation.

The most outstanding achievement of Gandhiji, in the field of politics, has been the practice of truth. To him the means was far more important than the end. He has succeeded in showing to the world that diplomacy and tact can go hand in hand with honesty and sincerity of purpose.

Despite differences of opinion and ways of thinking, all men honoured him for his intense sincerity and enormous courage of conviction. His way of reminding the world, that no man has a right to possess more while another has less, was to lead the simple life of the poor in all its actuality; his way of asking men to be self-reliant was tc weave his own cloth and cobble his owr shoes; his way of preaching equality of men and religions was to live with them all in loving friendship. These demonstrations simple as they were, went far towards the promotion of self-respect among his countrymen and of peace between communities.

While India remains ever in his debt foi his unrivalled leadership in the final phase of her historic emancipation, the world is grateful to him for the successful demonstration that political disputes betweeı nations can also be settled in ways othe than war—by moral force as against military might or machiavellianism, a metho which spells failure to neither party, but like mercy, blesseth him that gives an him that receives. By this exalted metho of persuasion Gandhiji exercised a powe unprecedented in the history of mankind.

Let us hope that posterity will have n cause to accuse the men of his generatio that his life and teachings were lost o them.

# EDITORIAL NOTE

## MISSIONS ON SCIENCE AND TECHNOLOGY

RECENTLY we have read an announcement that the United States will soon establish a Mission on Science and Technology in the American embassy at London. The object of the mission is to supply interested individuals and commercial firms with information on the latest developments in such fields as organic chemistry, biochemistry, physics, engineering, biology and agronomy, and to collect information on British developments for dissemination to government agencies and scientific societies in U.S.A. The mission will also assist in facilitating exchange of scientific personnel, develop and continue close personal contact with government agencies and research institutions in the United Kingdom, and generally stimulate exchange of reports of scientific and technological nature.

Such friendly contacts between differe countries are of obvious benefit to scientists an technicians as well as to the people who de pend on them for their material advancemen The establishment of such missions is, furthe one of the positive methods of promoting activ co-operation in the international sphere. T countries like India and China, with enormo potentialities of economic development, t more technically advanced countries like t United States, Britain and Russia could, by e tablishing such missions, give a helping ha and accelerate their progress. The Unit States and Russia are in a particularly adva tageous position in this respect, as the agricu tural industry is greatly developed in the countries. With their help it is clearly possib to cut short the period of modernisation a to attain the peak of agricultural producti and thus help in overcoming the critical shor age of world food supplies. We trust the Go ernment of India will take the necessary ste for the establishment of friendly foreign scie tific missions in India.

## IMPROVING THE POSITION OF MATHEMATICS IN INDIA*

"IT is not to our national interest to ignore the fact that the position of mathematics in the country is far from satisfactory", observed Prof. M. R. Siddiqi in his Presidential Address to the Fifteenth Biennial Conference of the Indian Mathematical Society. Referring briefly to the glorious past that mathematics has had in India, he dwelt on the unsatisfactory present, analysed the causes therefor, and offered some useful suggestions for the future.

Recalling the past, Prof. Siddiqi said, "The whole civilized world acknowledges the debt of gratitude it owes to this great country of ours for its early pioneering efforts in systematic mathematics. The discovery of the numerals and of the positional notation in arithmetic are two of the most fundamental and far-reaching contributions made by this ancient land to the evolution of civilised society. It is hardly possible to calculate the innumerable benefits that the human race has derived by the use of the mathematical discoveries of our ancestors in this country." He mentioned, in particular, the names of Aryabhatta and Bhaskara amongst the ancients and of Srinivasa Ramanujan of this age.

After this very brief reference to the past, Prof. Siddiqi deplored the fact that, at present, "compared to the size and the population of our great country, the number of mathematicians is much too small, and the number of those actively engaged in research is smaller still", and that "there are hardly two people in the country working on the same subject". He pointed out that the causes for this state of affairs are the defects in the present system of education, and the tendency of Government to encourage only "industrial research" losing sight of the importance of "fundamental research".

"The present system of education", said Professor Siddiqi, "introduces too early too narrow a specialisation in the secondary school stage itself, and the young students naturally take up those subjects which enable them to pass the examinations easily, *i.e.*, the arts subjects, or subjects for which there is more or less inflated market-value at present, *i.e.*, Chemistry and Biology .... Of the students who take mathematics in the High School and Intermediate, the majority do so not because they are interested in the subject itself but because they wish to take a degree in Engineering or some other technical subject." Students should not be expected to cram formulæ and reproduce them at examinations, nor should the specialisation be of the type of "knowing more and more about less and less". A system of general education should be introduced with due predominance to mathematics. Reform is necessary even at the university stage, where "much valuable time and energy of the students are wasted in studying topics which have lost any importance that they once possessed". Further, our educationists should appreciate the fact that "mathematics is woven inextricably into the structure of science and technology".

As a possible line for future research in mathematics, Prof. Siddiqi suggested problems relating to the Foundations of Mathematics as the suitable trend for research in this country. He made a rapid survey of the growth of this branch of mathematics, and in doing so, he referred to the rigour introduced by Gauss and Cauchy, to the "arithmetisation" during the 19th century, and specially to the subsequent schools of thought, *viz.*, the Intuitionistic school led by Brouvwer and Weyl, the Logistic school of Russel, and the Formalistic or Axiomatic school of Hilbert. Prof. Siddiqi hoped that this branch of mathematics would prove congenial to our countrymen, who have "a reputation abroad for possessing an extraordinary flare for abstract philosophical speculations and reasoning", and that "we may see some further developments in the subject in the near future".

B. SEETHARAMA SASTRY.

* Extract of Presidential Address delivered by Prof. M. R. Siddiqi to the Fifteenth Biennial Conference of the Indian Mathematical Society, held at Waltair, on 22nd December 1947.

## SOME ASPECTS OF PURE AND APPLIED WOOD ANATOMY*

FOREST wealth is one of our national assets endowed to us by bountiful nature. The towering giants of the Indian forests include species which yield us valuable timber. But in the absence of proper vetting much of this wealth may go to ruin. A sound knowledge of the interior make up of the trees is a *sin qua non* for the classification and understanding of our timber resources. Addressing the Section of Botany, Dr. K. A. Chowdhuri calls attention to the urgent need for sustained work in this branch of knowledge. Among the wide range of characters available to the anatomist only those that are not available are of any use in classifying wood. Dr. Chowdhuri's studies lead him to believe that rays embedded in fibrous tissue show a remarkable constancy in their shape and of their component cells. Equally so are the ripple marks formed by the rays for quick classification of timbers of broad-leaved trees. The plastic characters cannot be ruled out as criteria of classification, but their limit of variation remains to be determined. Dr. Chowdhuri pleads for more work in this direction.

Thrown on our own resources during the war, we were compelled to look for local substitutes for imported timbers. A number of local timbers proved excellent substitutes: the Indian spruce (*Picea morinda*) and the silver fir (*Abies pindrow*) were found to be as good as Sitka spruce of U.S.A. and Canada for making aircraft.

* Extract of Presidential Address of Dr. K. A. Chowdhuri to the Botany Section, Indian Science Congress, Patna, 1948.

After discussing some of his own contributions to the subject, Dr. Chowdhuri refers to gum- and resin-yielding trees. Here the type of incision is of paramount importance.

In the absence of standardised methods, much waste and vital injuries are caused to the trees.

K. V. S.

## THE VARIATION IN STATURE AND CEPHALIC INDEX AMONG BENGALEE COLLEGE STUDENTS*

THE data embodied in the address were obtained from the routine health examinations of the students by the Medical Board attached to the Students' Welfare Committee of the Calcutta University during 1922-28. The anthropometric measurements were taken according to the Monaco Agreement and were arranged and tabulated in relation to each of the six traditional zones of the province of Bengal, *viz.*, Radha, Varendra, Vanga, Chattala, Samatata and Calcutta, and five caste groups of peoples, *viz.*, Brahmins, Vaidyas, Kayasthas, other Hindus and Moslems. The data reflect the conditions prevalent among the rich and middle classes.

The mean of the stature is fairly equally distributed over the whole province except for Calcutta. There is great resemblance between the first three zones. The last two zones are characterised by a tendency to tallness and roundheadedness.

Further elucidation of the data is made on the basis of a classification of the individuals into nine types of correlation of stature (tall, medium and short) and Cephalic index (dolicho-, meso- and branchycephals), and the percentile incidence of the different types in the six zones is noted. Further group differences in the six different zones and the zonal fluctuations in the same group on the basis of caste are tabulated.

The fact that there is a great deal of ethnic unity and homogeneity is brought out by the following findings which emerge from the data. The medium mesocephals and medium brachycephals constitute the most predominant type among the Brahmins and the Vaidyas. The medium mesocephals predominate among other Hindus and the Moslems. There is considerable variation in the Cephalic index among the Kayasthas. Dr. Chatterji, in conclusion, envisages the emergence of a united people with close cultural and linguistic bonds.

C. J. JAYADEV.

* Extract of Presidential Address of Dr. A. Chatterji to the Anthropological Section, Indian Science Congress, Patna, 1948.

## BLOOD-FLUKE PROBLEM IN INDIA*

COMPARED with any other single group of parasites, blood-flukes or schistosomes rank foremost in undermining the health of almost all domestic animals in India. It is a subject in which both Veterinary and Medical professions are interested alike. Dr. Bhalerao in his Presidential Address has given an idea of the work that has been done in India on these parasites and suggested measures for their control. Reference has also been made to cercarial dermatitis of man which so far as the research of the author has progressed appears to be localised only in certain localities in India.

As a result of the work of Montgomery (1906) and several other workers during the past three decades, seven authentically identified species of schistosomes have been recorded from India, *viz.*, *Schistosoma hæmatobium*, *S. spindalis*. *S. nasalis*, *S. indicum*, *S. incognitum*, *Ornithobilharzia bomfordi* and *O. nairi*. Of these the first one has been sporadically recorded from man, while the remaining six have been known to parasitise only the domestic animals.

Montgomery first found *Schistosoma spindalis* in the mesenetric vessels of two plain cattle (*Bos indicus*) at Mukteswar and described the morphological features of the adult worm and their spindle-shaped ora. Bhalerao (1932) discovered in cattle from Bihar another variety of *S. spindalis*, in which the males had a smooth cuticle, whereas the males described by Montgomery had a tuberculate cuticle. It has been observed that alimentary infection with *Schistosome cercariæ* occurs only in ruminants owing to the peculiar anatomical and physiological differences in the stomach of these animals. *Schistosome cercariæ* cannot survive the normal acidity of the gastric content in animals other than ruminants.

Fairly and collaborators developed in this country serological method of diagnosing bilharzia infection. As a result of numerous complement fixation tests it has been concluded that the cercarial antigen of *S. spindalis* is of a group nature and can be used successfully in detecting infestation by *S. hæmatobium*, *S. mansoni*, *S. japonicum*, *S. boris*, *S. spindalis* and *S. indicum*. Pleural peritoneal and pericardial transudates and exudates will yield positive complement fixation reaction in infected animals provided the blood shows similar reaction. Regarding the treatment, it has been found that tartar emetic is capable of curing *S. spindalis* infection in goats. The female worms are affected more by anthelmentics than by male ones. Intravenous injection of emetine hydrochloride has more efficient anthelmentic properties than tartar emetic, but is more toxic.

Unlike other species of Schistosoma, *S. nasalis* occurs exclusively in the nasal veins of the

* Summary of the Presidential Address delivered by Dr. G. D. Bhalerao before the Section of Medical and Veterinary Sciences, Indian Science Congress, Patna, 1948.

host. Usually cattle and rarely buffaloes are infected, but sporadic cases occur in goats. One case of equine infection was brought to the notice of the author. A thorough description of both the male and female parasite was first given by Bhalerao (1932). According to the available data the disease occurs in Bombay, Madras, Central Provinces, Bihar, Assam, Orissa, Mysore, Bengal and also in Burma. Antimony tartrate is the drug of choice for the treatment of this infestation.

Prior to 1932, *S. indicum* was known to occur only in the horse, donkey, sheep and camel, when Bhalerao (1932) recorded its presence in cattle and goats from various localities in India. Montgomery was the first to describe this species, later Bhalerao (1932) added materially to the original description of this parasite. The life-history of this important parasite still awaits elucidation.

Chandler (1926) recorded from the supposed human stool asymetrical schistosome eggs with a subterminal spine, and assigned these ova to a new human species of schistosoma—*Schistosoma incognitum*. In addition to porcupine hosts, *S. incognitum* parasitises dogs as well.

*Ornithobilharzia bomfordi* was found only once in a plain cattle at Mukteswar by Montgomery. Along with *S. spindalis*, Price (1929), assigned this species to the genus *Ornithobilharzia*, remarking that some birds must have been the definitive host of this species and that bovine infection was purely accidental.

Madaliar and Ramanujachari (1945) identified a species from the elephant and designated it *Schistosoma naini*. On account of the anatomical peculiarities of both the male and female worms, this species could not be retained in the genus, schistosoma, and Bhalerao assigned it to Ornithobilharzia in 1947.

There are a few records in this country of indigenous human schistosomiasis. Mello (1936) quotes one definite case of urinary bilharziasis in a child who showed numerous ova of *S. hæmatobium* in urine and fæces. Recently Andreasen and Suri (1945) reported a case where large number of ova of *S. hæmatobium* were detected in urine.

From the scanty report, it would appear at the first sight that human bilharziasis is not a very serious condtion in this country. It, however, transpires that some molluscs in this country are capable of harbouring the larval stages of the human schistosome, *S. hæmatobium*, and this fact offers a clue to explaining the sporadic occurrence of the cases of bilharziasis in this country. This need not, however, alarm us, for the clinical, epidemiological and experimental data, obtained so far, do not warrant the conclusion that urinary bilharziasis may become endemic in India.

Cort (1928) was the first to demonstrate that non-human schistosome cercari produces the "swimmer's itch". Bhalerao recently encountered similar conditions in men bathing in some tanks in the Mysore State. Examination of the snails from the tank revealed the presence of two species of cercariæ.

Bhalerao concludes by saying that schistosomiasis, particularly in domestic animals is a very serious condition and causes considerable monetary loss to the stock-owner in this country. Streuous efforts should, therefore, be made to control this condition. Such masures will not only eliminate schisosomiasis but will also exterminate other fluke diseases, both of men and animals existing in this country.

N. N. De.

---

# BETA-RAY COUNTERS

R. S. KRISHNAN

(*Department of Physics, Indian Institute of Science, Bangalore*)

## I. Introduction

IONISATION chambers and Geiger counters are very frequently used for detecting and measuring the radiations emitted by artificial radio-active bodies. Although ionisation chambers are easily made they are not suitable for measuring very weak $\beta$ or $\gamma$-rays, since a limit to the measurement of very weak radiations is set by the background ionisation or rather by its statistical fluctuations. For reliable measurements with ionisation chambers and electroscopes, the source should be much stronger than that required for measurements with counters. Moreover, ionisation chambers are not useful for studying nuclear isomerism and K-capture by the coincidence method, whereas Geiger counters are indispensable for such studies. Much work has been done and many papers have been published on the construction and performance of Geiger counters. But often contradictory views have been expressed by workers in different laboratories. In connection with the investigations on the deuteron-induced disintegrations in the heavy elements, the author studied in some detail the methods of construction and behaviour of counters suitable for measuring $\beta$-ray activities of radio-active products. The results of these studies which were carried out in the Cavendish Laboratory at Cambridge (which are not at all outmoded now) are presented in this article.

## 2. The Mechanism of Extinction in Counters

The counter is essentially an ionisation chamber in which the intensity of the electric field is such that a discharge does not set in spontaneously but is started by the ionisation produced by the incoming particles. The discharge thus produced is not allowed to become permanent, but is interrupted automatically after a very short time in order that the apparatus may be reset in a proper condition for registering the next particle. The point and the tube counters work on the same principle, although the tube counter is more sensitive than the point counter. The sensitivity of the counter is not very much influenced by the energy of the particles counted,

Fig. 1 (*a*) shows the electrical connections of a counter and Fig. 1 (*b*) is a typical characteristic curve for a counter. $V_1$ is the voltage at which the counter begins to record impulses. From $V_{min.}$ to $V_{max.}$ the number of counts recorded with a given radio-active source remains constant. When the voltage is increased above $V_{max.}$ the number of impulses increases very rapidly until at $V_2$ a steady discharge takes

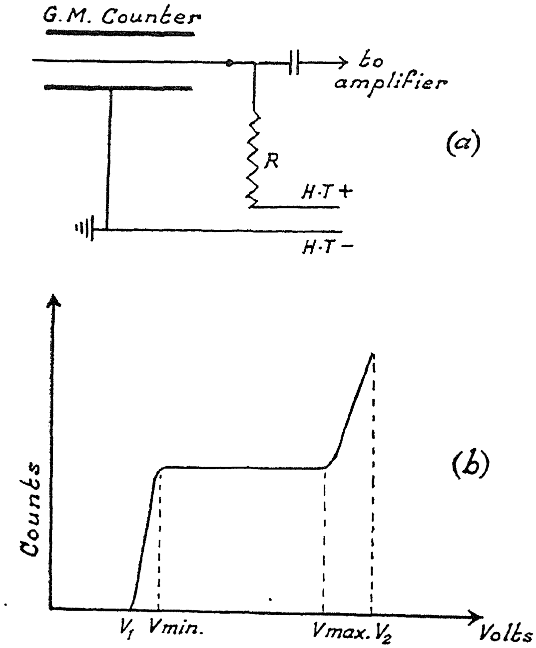



FIG. 1

place. In the absence of the resistance R (Fig. 1*a*), continuous discharge sets in as soon as the voltage is raised to $V_{min}$. It has been shown by Werner[1] that if a resistance R is introduced in the circuit, a permanent discharge can occur only if the voltage applied to the counter is greater than $V_{min.} + I_{min.} \times R$ where $I_{min.}$ is the minimum current required for a discharge and is characteristic of the counter under investigation. $V_2 - V_{min.} = (I_{min} \times R$ gives a measure of the counting region. When the applied voltage lies between $V_2$ and $V_{min}$. during a discharge the counter voltage falls below $V_{min.}$, and the discharge is interrupted. The voltage across the counter rises again to the full value of the high tension supply and the counter is ready for registering the next incoming particle. The region of constant rate of counting, *i.e.*, $V_{max} - V_{min.}$, is only a part of the counting region. In order to have this region sufficiently large, R should be of the order of $10^8$ to $10^9$ ohms.

As is well known, the use of a very high resistance is rather a disadvantage in working with counters. Firstly the preparation of such resistances is not very easy. Secondly it sets a limit to the maximum permissible counting rate. After the passage of the discharge and the consequent fall in voltage across the counter, it is practically out of action for a time $t = t_g + t_{re}$, where $t_g$ is the duration of the discharge and $t_{re}$ is the time taken by the counter for the voltage to rise above $V_{min.}$ so as to make the counter active again. The time $t_{re}$, depends on R as well as on the capacity of the counter and is of the order of $10^{-2}$ sec. for $R = 10^9$ ohms. The net result is that particles would be missed from being recorded at high counting rates. One way of avoiding this difficulty is to use a special circuit suggested by Neher and Harper.[2] In this the extinction is effected by a valve. Another way of avoiding most of the difficulties is to use a self-extinguishing counter which was first developed by Trost.[3] He showed that counters filled with argon and alcohol vapour had a reasonably wide counting range which was independent of the external resistance, and hence the resolving time could be made very small.

## 3. CONSTRUCTION OF BETA-RAY COUNTERS

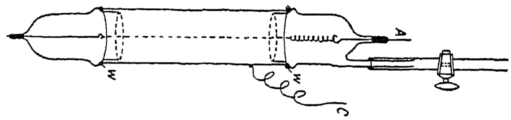


FIG. 2. Thin-walled Geiger-Muller counter
A = anode, C = Cathode, W = Wax seal

Thin-walled Geiger tube counters of the type shown in Fig. 2 were extensively used for measurements of $\beta$-ray activity. A thin metal tube of copper or aluminium (0·1 mm. thick) acted as cathode. In these counters the $\beta$-ray has to pass through the metal wall of the counter before it is detected. Due to the finite thickness of the wall, particles of energies below a certain value would be absorbed. Such counters are, therefore, not useful for measuring $\beta$-rays of low energy.

In order to measure the activity of substances emitting beta particles of low energy, the author developed some special types of counters. The most satisfactory one is shown

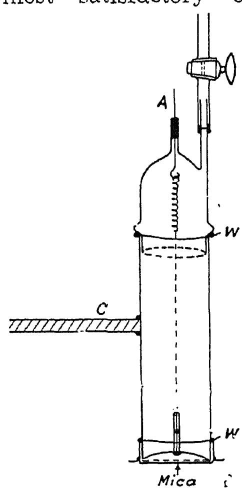



FIG. 3. Grid counter

in Fig. 3. This type was a slightly modified form of that used by Dr. Feather.[4] The coun-

ter was made up of a brass tube to one end of which was fixed a curved bridge with a hole in the middle. Through this hole passed a pyrex tube with a bead at one end. Into this narrow pyrex tube was fused one end of a piece of tungsten wire ($50\,\mu$ in diameter). The other end of this wire was attached to a tungsten hook through a tungsten spring in order to keep the central wire under tension. The tungsten hook was fused to a pyrex glass cap which was fixed to the brass tube with picein wax as shown in the figure. That end of the brass tube which held the bridge was closed by means of a brass cap provided with a grid. A piece of thin mica film (2 cm. air equivalent) was stuck on the grid. With this arrangement the counter could be made vacuum tight and at the same time the beta particles could enter the counter through the mica window. The pyrex glass cap was provided with a side tube and a glass tap for purposes of evacuation and filling in with gas. The counter was supported by means of a 3/16" rod soldered to the body of the brass tube. The counter was usually mounted vertically with a standard adapter for specimen holders fixed at a definite distance from the former. The specimen holders were made of brass and were of the same standard size. They were provided with standard cups for holding the radio-active sample. The whole arrangement was such that the radio-active sources could be removed from under the counter and brought back again exactly to the same position for counting.

Before assembly the parts of the counter were cleaned as follows:—The brass tube was well polished on the inside using the finest emery paper available and the dust from the inside was removed by running tap water under pressure through the tube. It was finally rinsed with distilled water and dried. The inside as well as the outside of the brass cap was well polished before fixing the piece of mica. The pyrex cap was cleaned by washing it with hot chromic acid and finally with distilled water. The $50\,\mu$ tungsten wire which formed the anode was cut from a fresh spool, washed with benzene and alcohol and was heated to a dull red heat in a small flame. After assembly, the counter was evacuated and was filled with pure argon and absolute alcohol vapour in the ratio of 9 : 1 to make up a total pressure of 10 cm. of mercury. This ratio was first suggested by Trost.[3] A counter constructed on the lines indicated above gave a good characteristic with the counting region extending well over 300 volts.

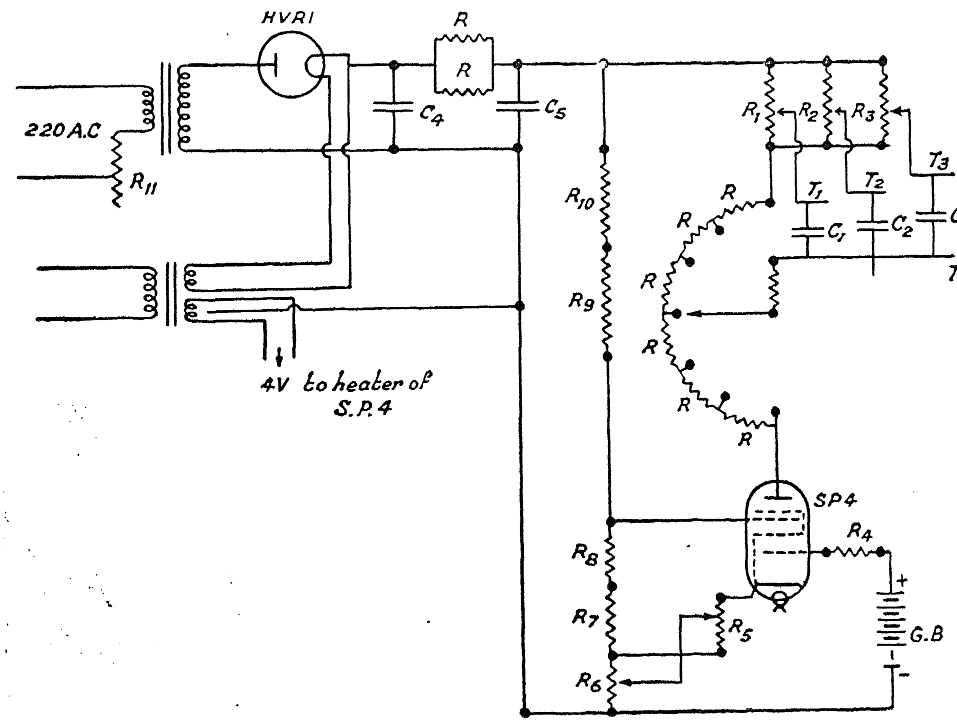



FIG. 4. Stabilised high tension unit for Geiger counters.

R=250,000 ohms; $R_1$, $R_2$ and $R_3$ = one Megohm each; $R_4$ = 2 Megohms; $R_5$ = 25,000 ohms (variable), $R_6$ = 15,000 (variable); $R_7$ = 50,000 ohms; $R_8$=100,000 ohms; $R_9$, $R_{10}$, $R_{12}$ = each one Megohm; $R_{11}$ = 400 ohms; $C_1$, $C_2$, $C_3$ $C_5$ = each $0{\cdot}1\,\mu F$; $C_4$ = $0{\cdot}2\,\mu F$. $T_0$, $T_1$, $T_2$ and $T_3$ = output terminals.

## 4. HIGH TENSION UNIT

A stabilised high tension unit with the output varying from 0 to 1,500 volts forms an integral part of any counting system using a Geiger counter. Many circuits using vacuum

tubes for stabilising the output voltage have been described in the literature. The circuit adopted by the author for the construction of the stabilised high tension supply was the one suggested by Lewis.[5] It is shown in Fig. 4.

It is a slightly modified form of Street and Johnsons' circuit.[6] The stabilisation of the output voltage was effected by a pentode. $R_5$ was the standardising resistance. This, in conjunction with the bias battery, could be adjusted to give 1 mA. stabilised current so that each step on the range switch was equal to 250 volts and the control resistance, $R_1$, $R_2$ or $R_3$ also covered about 300 volts. Stabilisation was made by adjusting $R_6$. The stabilising action could be tested by changing the input volts by varying the test stabilising resistance $R_{11}$ while measuring the output with an electrostatic voltmeter. The high tension supply was provided with three tappings coming from the three control resistances, $R_1$, $R_2$ and $R_3$. This was quite useful for doing work on double or triple coincidence. Three counters could be supplied with the necessary voltages from the same set, provided the operating potentials did not differ from one another by more than 250 volts.

## 5. Amplifier

The counter was coupled to a single stage amplifier as shown in the accompanying Fig. 5. The amplifier was both a single stage amplifier and a Rossi mixer circuit useful for coincidence work. It was mainly used as a single stage amplifier keeping the grids of the second and third valves heavily biased. The output from the amplifier was fed on to the discriminator of a thyratron scale of eight circuit.

## 6. Resolving Time of the Counting Set

The nature of the impulses produced in a good counter constructed as per details given in Section 3, was visually examined with the aid of a cathode-ray oscillograph. The impulses were resonably sharp with an average resolving time of $10^{-4}$ sec. The resolving time of the whole counting system was determined by the well-known coincidence method. Two identical counters were connected to two valves of the amplifier mixer circuit and two separate sources were placed under the counters. The two counters were well protected from each other so that the electrical impulses from one did not influence the working of the second one. The number of counts registered by each counter was recorded first and then the accidental coincidence rate was determined with and without the sources under the counters. The finite resolving time $t$ of the counting set was calculated from the formula,[7]

$$A = 2 N_1 N_2 t + c,$$

where A is the number of chance coincidences per sec., $N_1$ and $N_2$ are the number of counts per sec. recorded by each counter separately and $c$ is the number of coincidences due to penetrating radiations alone. The chance coincidence rate A was determined for various values of $N_1$ and $N_2$, and the finite resolving time $t$ was evaluated from the above formula after eliminating c. The resolving time was less than $10^{-4}$ of a second.

## 7. Efficiency of the Counting System

Before using any counting system consisting of a Geiger counter, amplifier and the scale of eight for quantitative measurements, it is necessary to determine its overall efficiency. The efficiency of the recorder system used by the author was estimated by feeding in a known number of counts having a random distribution. Seven different capsules were taken, and into each was put some uranium oxide sufficient to give about 100 counts per minute. These capsules went into specified holes in a specimen holder which were marked 1, 2, ........ 7. Capsules, when used, were placed in their respective holes and counts given by each individually were determin-

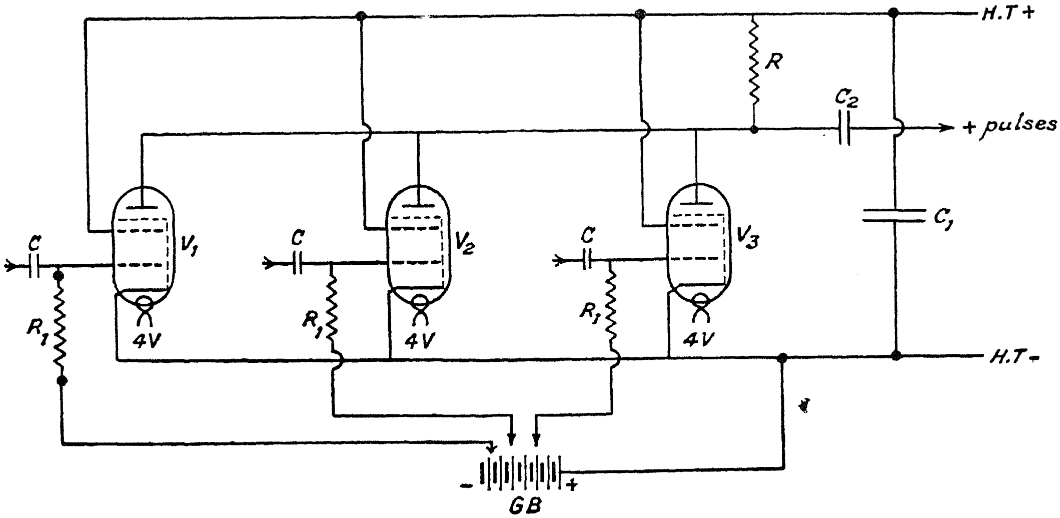



FIG. 5. Amplifier and Rossi mixer circuit for Geiger counters.

R = 10 Megohms; $R_1$ = 2 Megohms; $R_3$ = 30,000 ohms; $C_0$ = 50 $\mu\mu$F; $C_1$ = 4$\mu$F; $C_2$ = 0·01 $\mu$F.

ed. The calibrated sources were then used in combination and the sum of the individually determined values was taken as the true input. In this method the sources were so weak that the counting losses from any one source

TABLE I

| Capsules | | | | | | | Count /min. observed | Counts/min. calculated | % Difference |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | $84 \pm 5$ | | |
| 2 | | | | | | | $128 \pm 5$ | | |
| 3 | | | | | | | $106 \pm 5$ | | |
| 4 | | | | | | | $140 \pm 6$ | | |
| 5 | | | | | | | $110 \pm 5$ | | |
| 6 | | | | | | | $171 \pm 6$ | | |
| 7 | | | | | | | $108 \pm 5$ | | |
| 1 | 2 | | | | | | $209 \pm 7$ | $212 \pm 7$ | $-1{\cdot}5 \pm 4{\cdot}5$ |
| 1 | 2 | 3 | | | | | $315 \pm 8$ | $318 \pm 8{\cdot}5$ | $-1 \pm 3{\cdot}5$ |
| 1 | 2 | 3 | 4 | | | | $440 \pm 9$ | $458 \pm 10{\cdot}5$ | $-4 \pm 3$ |
| 1 | 2 | 3 | 4 | 5 | | | $573 \pm 4$ | $568 \pm 12$ | $+1 \pm 2$ |
| 1 | 2 | 3 | 4 | 5 | 6 | | $726 \pm 13$ | $739 \pm 13$ | $-1{\cdot}8 \pm 2{\cdot}5$ |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | $873 \pm 13$ | $880 \pm 14$ | $-0{\cdot}8 \pm 2$ |

were assumed negligible. Table I gives the experimental and the calculated values of the counts. The error for the sum was calculated from the formula $e = (e_1{}^2 + e_2{}^2)^{1/2}$ where $e_1$ and $e_2$ were the errors in the two sets of counts when measured individually.

As would be evident from the table, for counts up to 900 per min. the efficiency of the counting system was very nearly 100 per cent.

The method was extended to higher counting rates. The seven capsules were filled with uranium oxide, each sufficient to give about 900

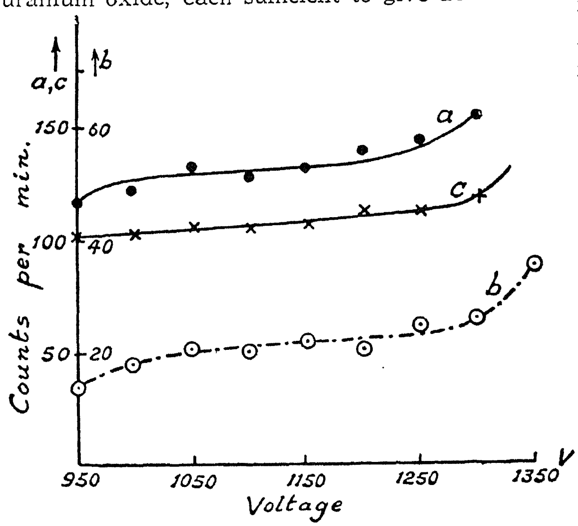



FIG. 6. Characteristic of a Geiger counter

counts per min., and the experiments were repeated. It was found that with the counting system used by the author, the losses became appreciable when the number of particles counted exceeded 2,000 a min. The counting efficiency steadily decreased and at 5,000 particles a min. the efficiency was about 95 per cent. When the number exceeded 7,000 a min., the mechanical meter attached to the scale of eight unit got jammed. The low efficiency of the counting system was due to the fact that the mechanical meter used was a very old and heavy one.

### 8. COUNTER CHARACTERISTIC

A large number of counters of the type shown in Fig. 3 were constructed. The characteristic of a good one is reproduced in Fig. 6. Curve *a* represents the total counts, curve *b* the natural of the counter and curve *c* the net counts due to the radioactive source alone. Uranium oxide was used as a standard source. As would be evident from the curves, this counter had a flat portion extending from 950 to 1,250 volts over which the number of counts recorded remained constant. While taking measurements, this counter was usually worked at a potential of about 100 volts above the starting voltage. The counters with mica windows had a natural count varying from 20 to 40 per min. In most cases the natural was not affected by bringing a strong source for measurement. In order to check whether the counter was behaving properly, the natural of the counter and also the strength of a standard uranium source were measured at frequent intervals. The characteristics of counters with mica windows, if properly made, remained satisfactory for periods extending over a year or more.

The effect of the partial pressures of argon and alcohol on the counter characteristic was studied and the best characteristic was obtained when the partial pressures of argon and alcohol were in the ratio of 9 : 1. The value of the quenching resistance was found to have no appreciable effect on the characteristic of a counter filled with argon and alcohol, although it affected the size of the pulse transferred to the amplifier. These results were in accordance with the observations reported by Trost[3] and Curran and Petrzilka.[8] It was found that if the pyrex glass cap was replaced by a cap of soft glass, spurious pulses were recorded due to electrical leaks.

### 9. SOFT β-RAY COUNTERS

Radioactive isotopes having very long periods are in general very weakly activated, and the radiations emitted by them are often very soft. An ordinary counter in which the particles have to pass through a mica window of thickness equivalent to about 3 cm. of air, before entering the counter is not very efficient for detecting and studying the soft radiations emitted by weak radioactive bodies. A special type of counter suitable for the study of the soft β-ray spectra was constructed by Libby and Lee.[9] Two types of soft counters of simple design were constructed by the author, one of which was used for detecting and measuring the half periods of radioactive isotopes, while the second was employed for the measurement of absorption in aluminium of the radiations emitted. In both the types the active substance was placed inside the counter.

The counter of the first type is shown in Fig. 7. It is substantially the same as that

shown in Fig. 3. Instead of the grid cap it was provided with a glass collar and a ground-in stopper which carried the specimen holder. After inserting the active substance into the

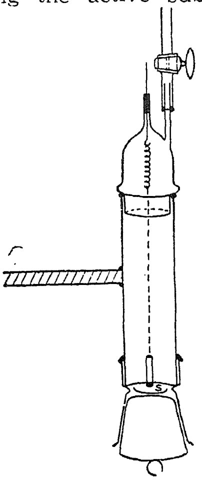


FIG. 7. Soft $\beta$-ray counter. S = specimen holder.

counter, it was evacuated and filled with the required amount of argon and alcohol. The absorption was almost negligible inside. In a counter of this type the natural characteristic had to be determined beforehand. After inserting the substance and filling the counter with argon and alcohol, the counter potential was set at the predetermined value, and the activity was measured. The chief drawback in counters of this type was that the natural, the counts due to some standard source and the counts due to radioactive sample under examination could not be measured simultaneously without opening the counter, evacuating and filling it every time with alcohol-argon mixture. It was found that if sufficient care was taken in letting in dust-free air and if the counter was not unduly exposed to the atmosphere, the natural as well as the characteristic of the counter could be reproduced within the limits of experimental error.

The defect mentioned above was, however, eliminated by adopting the following modification in the construction of the counter. The counter part was housed on a side tube attached to the middle portion of a wide glass tube about 9″ long. One end of this tube was drawn out and fused, while the other end was closed by means of a rubber stopper. A steel rider slided along a rod which was fixed axially inside the wide glass tube. The rider was four inches long and at its two ends were fixed two specimen holders, one for the radioactive sample under investigation and the other for a standard source. The rider could be moved along the rod by means of an electromagnet. By placing the rider symmetrically below the counter, its natural was determined. The reliability of the counter was checked by taking measurements with the standard source at frequent intervals.

For absorption measurements of very weak radiations either soft $\beta$-rays or soft X-rays, the counter shown in Fig. 8 was developed by the author. The counter part was similar to that shown in Fig. 2 with the difference, namely, that the cathode cylinder was made of fine copper gauze. The counter was mounted horizontally inside a pyrex bell-jar. The glass cap of the counter was fitted into the side tube which held the counter in position. The radioactive preparation was placed inside a specimen holder, S, which was fixed to the stopcock. Aluminium absorbers were mounted on a drum which was provided with sufficient number of apertures. The drum was capable of rotation by means of a handle, H, which could be operated from outside. A paper scale was fixed on the drum and a mark was made on the top of the bell-jar. By turning the handle, H, and noting the position of the mark on the scale, any particular absorber could be brought over the source. One of the absorbers was of lead with a thin aluminium foil over it. The thickness of the lead foil was such that it was capable of effectively cutting off soft X-rays and the aluminium foil over it would absorb the photo-electrons ejected from the lead absorber. The specimen holder was in the form of a tall cylindrical box and the size of the

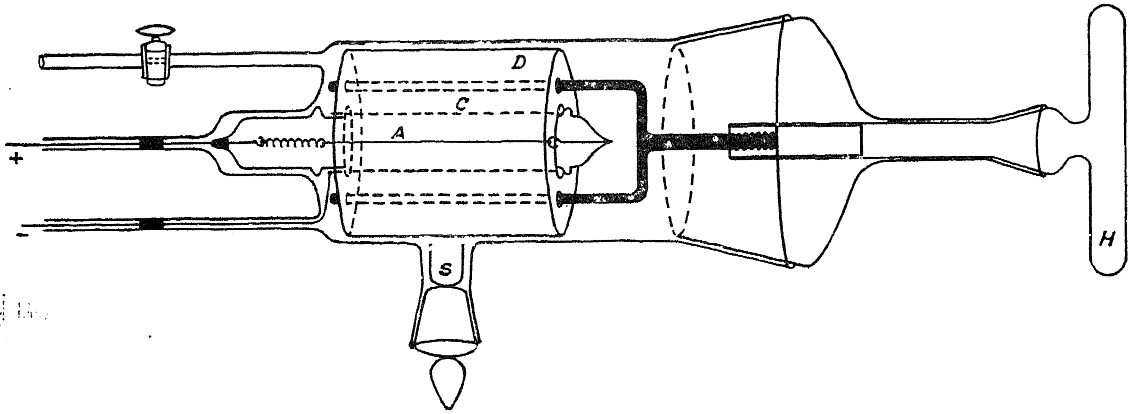



FIG. 8. Demountable soft $\beta$-ray counter. A = anode, C = cathode; D = drum containing the absorbers; S = specimen holder and H = handle for rotating the drum.

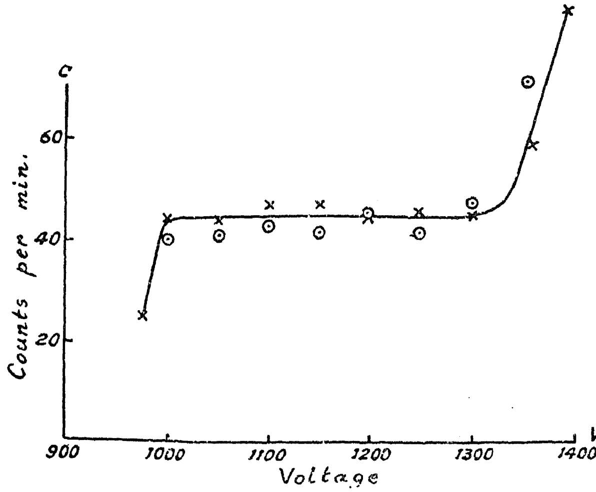



FIG. 9. Characteristic of a demountable soft $\beta$-ray counter. Circles—when the counter was first assembled Crosses— after two months of use.

drum was such that the absorbers formed a cover for the specimen holder. This prevented the particles emitted by the radioactive source getting away through the sides and finally finding their way into the active region of the counter and giving spurious results. The cylindrical form also helped to canalise the particles.

A counter constructed on the lines indicated above worked quite satisfactorily and its characteristic is shown in Fig. 9. This counter was successfully used for measuring the absorption in aluminium of the soft electrons emitted by the 6·7 hr. and 1 year cadmium isotopes.

1. Werner, *Zeits. f. Phys.*, 1934, **90**, 334, 1934, **92**, 705. Henning and Schade, *Zeit. f. Phys.*, 1934, **90**, 597. 2. Neher and Harper, *Phys. Rev.*, 1936, **49**, 940. 3. Trost, *Zeit, f. Tech. Phys.*. 1935, **16**, 407. *Phys. Zeit.*, 1935, **36**, 801. *Zeit. f. Phys.*, 1937, **105**, 399. 4. Feather, *Camb. Phil. Soc. Proc.*, 1938, **34**, 115. 5. Lewis, *Journ. Sci. Instruments*, 1938, **15**, 353. 6. Street and Johnson, *Journ. Frank. Inst.*, 1932, **214**, 155. 7. Feather and Dunworth, *Proc. Roy. Soc.* (A), 1938, **168**, 566. 8. Curran and Petrzilka, *Proc. Camb. Phil Soc.*, 1939, **35**, 309. 9. Libby and Lee, *Phys. Rev.*, 1939, **55**, 245.

*Note.*—The cost of printing this contribution has been met from a generous grant from the Rockefeller Foundation for the publication of results of scientific work made to us through the kindness of the National Institute of Sciences, India.

## TTT-CURVE DATA AND THEIR APPLICATION

G. P. CONTRACTOR
*(National Metallurgical Laboratory, Council of Scientific and Industrial Research)*

SINCE the publication of the original paper by Davenport and Bain[1] in 1930 much interest has been shown by metallurgical workers in the study of isothermal transformation of austenite. Investigation on the effect of alloying elements and the nature of austenite on the position of the S-curve have added to our knowledge of the mechanism of the kinetics of the transformation in austenite. The original steels investigated by Davenport and Bain[1] gave curves of such a shape as to suggest the term S-curve for this type of isothermal transformation. Since then, alloy steels have been investigated in which there are three temperature ranges of rapid transformation, instead of two as on the plain carbon steels, and those are not in any way suggestive of the letter 'S'. Figs. 1 and 2 respectively show these two types of curves. The term "isothermal transformation diagrams" and "TTT-curves" (time-temperature-transformation curves) also have the same meaning as the term S-curve. The term TTT-curve has been adopted in this contribution.

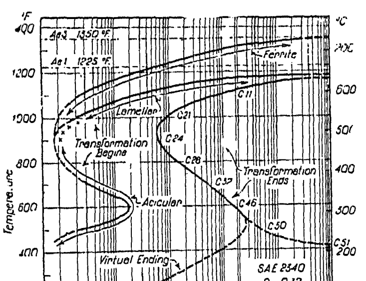


FIG. 1. Isothermal transformation curve for S. A. E. 2340 steel (Ref. 6).

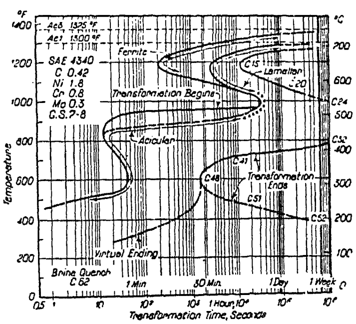


FIG. 2. Isothermal transformation curve for S. A. E. 4340 (Ref. 6).

This paper is prepared with a view to assembling important features on TTT-curves and their applications and interpretation. The purpose has been to indicate its applicability in heat treatment of steels.

### Determination of TTT-Curves and Their Characteristics

The TTT-curve for a steel records the time taken for the beginning and ending of the decomposition of austenite at any sub-critical temperature. Due to the fact that a wide range of times are required, it is necessary to plot the results with a logarithmic time scale and linear temperature scale, so that details for the short periods can be clearly indicated.

A TTT-curve may be determined in various ways. The methods that have been employed include microscopic and dilatometric determinations,[1] electrical resistivity,[2] and magnetic induction measurements.[3] Of the methods mentioned the microscopic yields data which are easily interpreted. The method consists in (*a*) transforming small steel samples into austenitic condition, (*b*) transferring them to a liquid bath maintained at a temperature under study for various lengths of time, and (c) quenching to room temperature. The samples are then polished and etched for microscopic examination which indicates when visible transformation has taken place. The untransformed portion of austenite left over at the end of the time in the liquid bath is transformed to martensite by quenching to room temperature. A partially transformed sample would thus consist of a mixture of a product characteristic of the holding temperature and some martensite.

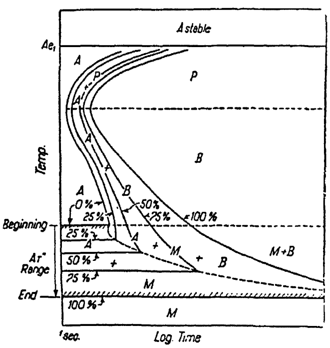



FIG. 3. Modified TTT-Curve Full lines represent per cent. austenite transformed (Ref. 5). A–Austenite; P–Pearlite; B–Bainite; M–Martensite.

The original TTT-curve of Davenport and Bain[1] suggested that the products of transformation of austenite could result isothermally. However, the work of Greninger and Troiano[4] indicates that the change of austenite to martensite could not be an isothermal reaction but occurred instantaneously on cooling below a certain temperature known as "M" point. Accordingly, the presentation of the lower part of the TTT-curve (Fig. 3) had to be changed, as suggested by Cohen. Since the work of Davenport and Bain many investigators[6,7,8] have studied steels by the isothermal method.

### Factors Influencing the Position of TTT-Curve

Certain precautions are essential in the application of data from TTT-curve.

For a steel of given chemical composition the outline of the TTT-curve can vary over a wide range, dependent upon the condition of austenite prior to quenching. The condition of the austenite in relation to hardenability can be defined in terms of the "as quenched" austenite grain size and the degree of solution of the carbides. Roberts and Mehl[9] in their paper on the influence of inhomogeneity of austenite on the rate of austenite-pearlite reaction have shown that the undissolved carbides not only reduce the effective carbon content, but also work as nuclei for the formation of pearlite. The influence of undissolved carbide on the position of the curve is illustrated in Fig. 4.

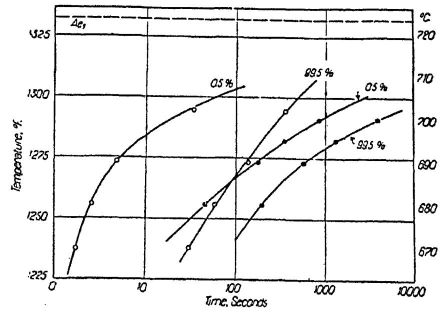



FIG. 4. TTT-curves for reaction from homogeneous austenite are shown by pair of curves at right, and from austenite containing undissolved carbide are shown by the pair of curves at left. These curves are for eutectoid steel (Ref. 18).

The effect of alloying elements on the isothermal portion of TTT-curve was studied by Davenport[6] in 1939. It was observed that all the common elements studied, except cobalt, shifted the TTT-curve toward the right. The influence of alloying elements on the "M" point (Martensite transformation point) has been determined by Greninger,[10] and by Payson and Savage.[11] The latter suggested the following equation to determine the effect on "M" point: M (° F) = 930-570 C-60 Mn-50 Cr-30 Ni-20 Si-20 MO-20 W, where the elements are given as

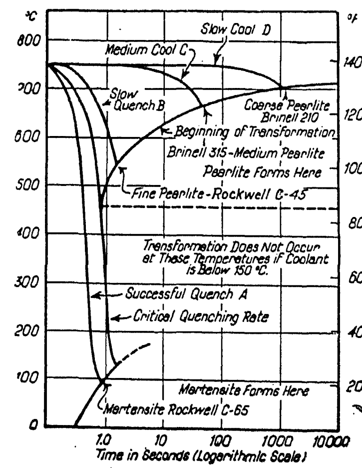



FIG. 5. Schematic representation of relation between cooling rate and temperature of initial transformation for carbon steel (Ref. 6).

per cent. by weight. Although the equation is not precise, the results obtained in most instances are satisfactory for practical application.

It is important that, in order to apply quantitatively the isothermal data, the steel should undergo transformation at constant temperature so as to satisfy the conditions under which the original diagram is prepared. Further, the engineer must ascertain that the condition of austenite and chemical composition are identical with those of the steel from which the isothermal curve is determined.

### Cooling Diagrams

For practical purposes the engineer should be able to predict the transformation products that will be obtained on continuous cooling of the work. This necessitates a relationship between isothermal transformation data and the continuous cooling data. A schematic cooling diagram showing the structures produced by several cooling rates is shown in Fig. 5.

The diagram indicates the changes of steel S.A.E. 2340 whose TTT-curve is shown in Fig. 1, in which either pearlite or martensite is produced, dependent upon the critical cooling rate. In this case no bainite is formed as it is sheltered by "nose" (point where the tangent to the beginning line of the TTT-curve is parallel to the temperature axis). In high alloy steels, however, it may be possible to exceed the critical cooling rate in the pearlite range and yet cut the second "nose" as shown in Fig. 2 during subsequent cooling, so that some bainite may be formed.

Grange and Kiefer[12] developed an empirical method of deriving a continuous cooling transformation diagram from the conventional transformation data (Fig. 6), and showed that the calculated curve agreed closely with experimental data obtained on continuous cooling. Grange and Kiefer made the following two basic assumptions:

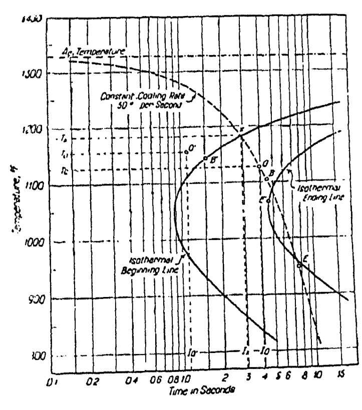


FIG. 6. Diagram showing a portion of the isothermal transformation figure for plain carbon eutectoid steel and a constant cooling rate of 50 deg. F. per second plotted from $Ae_1$ temperature (Ref. 12). This diagram illustrates the steps involved in the method for relating transformation on cooling to the isothermal figure.

(1) That "the extent of transformation of the austenite at the instant it cools to the intersection point (Fig. 6) is not substantially greater than it would have been if quenched instantly to $T_x$; in other words, some additional cooling time will be required before any measurable transformation occurs, in all cases of practical interest."

(2) That "on cooling through a limited temperature range, for example, $T_x$ and $T_o$, the amount of transformation is substantially equal to the amount indicated by the isothermal diagram at the mean temperature $\frac{1}{2}(T_x + T_o)$ after a time interval $I_o$–$I_x$."

Assumption (1) implied that when the work cooled to point X (Fig. 6), austenite has hardly decomposed, so that it is necessary to hold at this temperature $T_x$ almost as long as $I_x$. This condition is, however, more nearly approached with decreasing slope of the upper position of the isothermal transformation figure and with the fall in cooling rate.[13]

Assumption (2) is also strictly applicable when the period of nucleation is independent or varies as the first power of the temperature. Experience has shown that the assumptions are justifiable as the method gives satisfactory results.

One of the salient features of the above method of deriving a continuous cooling transformation curve is that all times are recorded from the A temperatures, since only the undercooling of austenite is effective in starting transformation process. Times after passing the $Ae_3$ are used for consolidating the transformation of pro-eutectoid ferrite or carbide; and times after passing the $Ae_1$ when considering transformation of pearlite or bainite. Diagram of S.A.E. 4340 prepared after Grange and Kiefer is shown in Fig. 7.

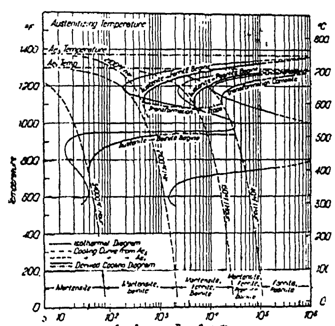


FIG. 7. Diagram showing austenite transformation on cooling at constant rate in S. A. E. 4340 steel (Ref. 12). This diagram was derived from isothermal data.

Steinberg[13] also developed a method of deriving cooling diagrams from isothermal transformation diagrams. Steinberg's method is more theoretical and takes into consideration the induction period of nucleation at all subcritical temperature levels whereas in the Grange and Kiefer method the nucleation periods are taken into account from the point where the cooling curve intersects the TTT-curve.

In addition to giving a satisfactory answer to austenite transformation on continuous cooling,

TTT-curve introduced many new methods of heat treatment, or variations of older ones, which are briefly surveyed.

### Austempering

Austempering is applied when bainite is desired in a low alloy high carbon steel. The steel is quenched from austenizing temperature in a liquid salt or metal bath maintained at some sub-critical temperature. It is important to bear in mind that the cooling velocity of the piece must be great enough to miss the "nose" of the TTT-curve (Fig. 8), thereby

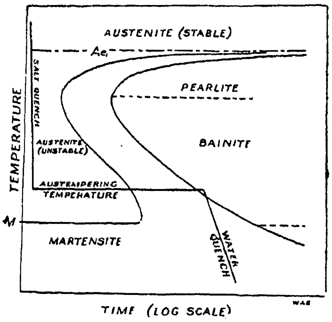



FIG. 8. Schematic diagram illustrating austempering (Ref. 19).

avoiding the formation of very fine pearlite. The work is kept immersed in this constant temperature bath until transformation is over. Although the work could be austempered at any temperature in the bainite zone, that is, just below the "nose" of the TTT-curve to the "M" point, the superiority in toughness of austempered structures over quenched-tempered structures of the same hardness is obtained only on the range of about 395 to 595 Vickers pyramid hardness (Rockwell "C" 40 to 55).

The above method is applicable to small sections as they could be cooled rapidly enough to avoid formation of pearlite at the centre. When alloying elements are added, the "nose" of the TTT-curve is shifted to the right resulting in increased transformation times in the bainite range. This restricts the amount of alloying elements that can be added for economical operation.

Attempts have been made to increase the size of the work that can be successfully austempered. One of the methods is to withdraw heat rapidly by quenching the section for a very short interval into oil or water at room temperature, before transferring to a liquid lead or salt bath. The main objection to this method is that deleterious stresses are developed. Another method proposed by Elmendorf[14] consists of cooling the whole work to a definite temperature below the "M" point to produce a certain amount of martensite throughout the work, and re-heating to a sub-critical temperature to transform the remaining austenite and temper the martensite. The structure produced comprises a mixture of bainite and tempered martensite.

### Martempering

Martempering was developed by Shepherd[15] and is designed to minimize the development of internal stresses on quenching large objects. The process (Fig. 9) consists in first quenching the object at a rate greater than the critical to a point slightly above the "M" point and

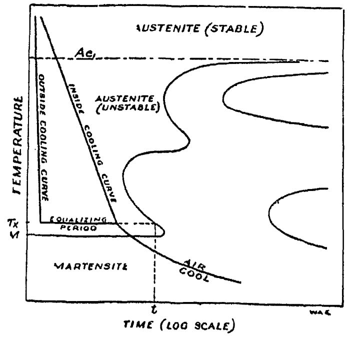



FIG. 9. Schematic diagram illustrating martempering (Ref. 19).

held there until thermal gradients vanish. The object is then allowed to cool in air. Such slow cooling minimizes the thermal gradient, so that martensite forms evenly throughout the object. The percentage of martensite developed depends upon the degree of cooling below the "M" point. If products other than martensite are to be avoided the work should be held above the "M" point for a period shorter than "*t*" at temperature $T_x$. For developing proper hardness the object can be tempered further.

### Isothermal Annealing

Isothermal annealing was comprehensively studied by Payson[16] and is schematically shown in Fig. 10.

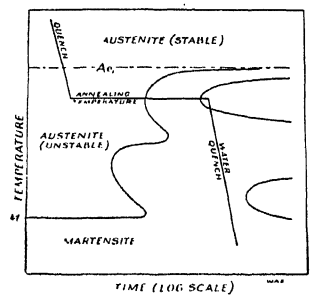



FIG. 10. Schematic diagram illustrating isothermal annealing (Ref. 19).

This process enables a considerable saving of time and is economical. For instance, annealing cycles of steels possessing high hardenability are so long that the treatment sometimes becomes uneconomical. A study of TTT-curve will, however, show that generally there is a minimum time for complete transformation at about 1200° F. It is, therefore, obvious that annealing at this optimum temperature can be carried on by isothermal transformation with less time and expense. It is important that this temperature range of minimum transformation time is sometimes very narrow, and must therefore, be determined with great care. The microscopic method is suitable for this determination.

It may further be pointed out that variation in early structures and austenizing treatments shift the TTT-curve so that the optimum temperature of transformation may vary appreciably for any steel.[9] Therefore, laboratory determinations of TTT-curves should be undertaken on material under identical conditions of early structure and austenizing as employed in the plant.

Despite the simplicity of TTT-curve, it must be remembered that this curve is always determined under specific conditions. According to Mehl[18] the following factors affect the position of TTT-curve:—

1. Variations in grain size.
2. Variations in composition.
3. Variations in carbide solutions.

Any variation in the above conditions must be accounted for in applying the data.

1. Davenport, E. S., and Bain, E. C., *Trans. A.I.M.E.*, Iron and Steel Division, 1930, **90**, 117. 2. Kote, F. B., Turckenmiller, W C., and Wood, W. P., *Trans. A.S.M.*, 1942, **30**, 1359. 3. Charles Nagler and William P. Wood, *Ibid.*, 1942, **30**, 491. 4. Greninger, A. B., and Troino, A. R., *Ibid.*, 1940, **28**, 537. 5. Cohen, M., See discussion to above reference No. 4. 6. Davenport, E. S., *Trans, A.S.M.*, 1939, **27**, 837. 7. Blanchard, J. R., Parke, R. M. and Herzig, A. V., *Ibid.*, 1943, **31**, 849, and *Ibid.*, 1941, **29**, 317. 8. Gorden, P., Cohen, M., and Rose, R S. *Ibid.*, 1943, **31**, 161. 9. Roberts, G. A., and Mehl, R. F., *Trans. A.I.M E.*, 1943, **154**, 318. 10. Greninger, A. B., *Trans. A.S.M.*, 1942, **30**, 1. 11. Payson, P., and Savage, C. H., *Ibid.*, 1944, **33**, 261. 12. Grange, R. A., and Kiefer, J. M., *Ibid.*, 1941, **29**, 85. 13. Steinberg, S. *Metallurg.*, 1938, **13**, (97), 7. 14. Elmendorf, H. J., *Trans. A.S.M.*, 1944, **33**, 236. 15. Shepherd, B. F., *Iron Age*, Feb. 4, 1943. 45; 1943, Jan. 28, 50. 16. Payson, P., *Ibid.*, 1943, **151**, No. 25, 47; 1943, **152**, No. 1, 48; 1943, **152**, No. 2, 14; 1943, **152**, No. 3, 70; 1943, **152**, No. 4, 60. 17. Roberts, G. A., and Mehl, R. F., *Trans. A.I.M.E.*, 1943, **154**, 318, 18. Mehl, R. F., *Trans. A.S.M.*, 1941, **29**, 813. 19. Cunnigham, R. L., and Arther Dubey, *Canadian M. and Met. Ind.*, 1944, **7**, No. 7, 22.

*Note.*—The cost of printing this contribution has been met from a generous grant from the Rockefeller Foundation for the publication of results of scientific work made to us through the kindness of the National Institute of Sciences, India.

# EFFECT OF AFTERNOON HEAT LOWS ON WINDS AT LOWER LEVELS

S. L. MALURKAR
(*Poona*)

THE question of diurnal variation on surface winds has been discussed elsewhere.[1] Mention was made of the large variation of winds at Ahmedabad on many days in winter even in upper air. On many mornings in late winter, the upper winds at Ahmedabad are N.W. or N.E., and have a speed of nearly 30 m.p.h. up to about 1·5 km. above m.s.l. But in the afternoon the wind speed drops down to as low a value as 5 m.p.h. An explanation can be easily given once the fact is known. When one of the low pressure areas of a western disturbance is approaching Kathiawar or south Rajputana, the seasonal high pressure area to the west of Ahmedabad gets intensified and gives rise to strong winds with some northerly direction. The strength of the seasonal high diminishes with height at the place. The more northerly low pressure areas of the western disturbance also limit the extent of the high pressure area. The vertical extent of the strong winds is, therefore, limited by the above considerations to about 1·5 km. The intensification of the high pressure leads to clear afternoon skies giving full play to solar heating. A low pressure area due to this solar heating is superimposed in the afternoons diminishing the strength of the high pressure area, and consequently the strength of the upper winds. The vertical extent of the heat low is also of the same order as 1·0 to 1·5 km. so that the diurnal variation of upper winds is most marked in this layer.

An equally remarkable diurnal variation can be observed at Mandalay in Upper Burma, in the clear season, *i.e.*, in the non-monsoon months. The upper winds up to about 1·5 km. show in the mornings large southerly components. But in the afternoons the southerly component diminishes very considerably. Sometimes even a small northerly component may actually be seen. The following table is based on an average of five to six years.

TABLE I
Components from South (miles per hour)

| Height | March | | April | | May | | October | |
|---|---|---|---|---|---|---|---|---|
| | M | A | M | A | M | A | M | A |
| 0·5 km. .. | 12·3 | −1·3 | 16·5 | 2·7 | 21·4 | 5·8 | 7·8 | −1·1 |
| 1·0 km. .. | 5·6 | −0·2 | 12·8 | 2·9 | 18·0 | 5·6 | 5·6 | +0·2 |

M—Morning. A—Afternoon.

The approximate location of the semi-permanent low pressure areas was derived from considering the fact that the low pressure areas are regions of upward convection. In the sunny afternoon near the hills or uplands, instead of the Katabatic winds uphill currents of Anabatic winds occur.[1] In the uplands or near the hills, the afternoon convection or upward air motion is greater than in the neighbouring plains. In other words, the uplands or hills behave as areas of low pressure. It is well known that the reduction of barometric pressure to the sea level or the neighbouring plain level shows on sunny days a relative low pressure area over the hills or the uplands. It may be thought that the effect of this has little significance. The winds at upper levels are determined not only by the pressure gradient but by the density of air which is dependent on the temperature distribution. The apparent low introduced by reduction of barometer is also

due to the deviation of the temperature distribution from an assumed value. When it is possible to work out these equations more rigorously, one can confidently expect that these apparent low pressure areas in the afternoon have their value in determining the winds.

Because of the orography of Upper Burma, there should be a semi-permanent low pressure area west of Mandalay as a feature in the dry season. As an afternoon effect a low pressure area should be superimposed due to Shan Hills. This superimposed low pressure area would be to the east of Mandalay, and would give rise to northerly winds which diminish the southerly components found in the mornings.

A further application of the afternoon low pressure areas over the hills can be made to explain the "Sea Breeze" to the east of Western Ghats in Peninsular India. Rice, in the *Gazetteer of Mysore*, mentioned long ago that sea breeze blows at Shimoga. It is known to occur in Hassan and Belgaum districts. Ramanathan[3] studied the sea breeze at Poona, but gave no explanation for its penetration so far from the coast.

It is generally considered that the sea breeze is due to differential heating of coastal land and sea. It is supposed to flow across the isobars for a distance not exceeding 15 to 20 miles inland. The depth of the sea breeze is also not great. But the places east of the Western Ghats are much farther away. There is a high range of hills with an average height of 2,000 to 3,000 feet between the sea and these places. One would have thought this as an obstruction across which the sea breeze would not penetrate. The sea breeze does not penetrate so far inland in the flat coast north of Bombay.

The author pointed out[1] that the wind at a place near the sea or hills is the resultant of the synoptic wind, *i.e.*, wind due to the prevailing circulation of the day and the effects of sea and land breezes, Katabatic (down hill) and Anabatic (up hill flow) winds. The sea breeze which flows across the north Konkan coast is accelerated by the heat low lying adjacent to the Ghats. Once the isobaric picture has been drawn carefully and completely, the idea of orography or the hills obstructing the flow should not again be considered. At the obstacle, the equations may not prove correct. But on either side of the obstacle or the range of hills, the wind given would be correct (*cf.* barrier equations in hydrodynamics and other similar subjects). The sea breeze which is accelerated by the heat low would blow much further inland than if the low did not exist. Because of momentum gained the wind would cross the central axis of the low due to the Western Ghats, until friction and pressure gradient against it wipe it out.

For the occurrence near the hills, it may be argued also in a slightly different and more easily understandable way. The sea breeze that reaches the foot of the hills on the western side of the Ghats is carried along with the uphill wind (Anabatic wind) to a higher height and allows the stream to cross the Ghats. As the time of maximum temperature is usually past by the time the wind reaches the top of the Ghats, the resultant wind flows down on the eastern side till its momentum is exhausted. There is absolutely no difference between this and the statement in the last paragraph, except that of a physical picture.

It is possible that the above offers an explanation to the strong westerly winds which blow in the summer afternoons in the plains of the United Provinces and the adjoining regions. At other hours, the wind strength dies down considerably. The morning isobaric picture is an increase of pressure to the north extending to the plateau of Tibet. Even in the afternoon charts, the pressure increases towards the north in the plains of the United Provinces. In fact, there is an afternoon heat low over the Peninsula. Due to the latter, one should have expected the winds to have some easterly direction. The fact that the winds blow W. or W.N.W. shows that in the summer afternoons, an apparent low must be forming and being superposed to the north of the United Provinces. As in the case of the Shan Hills, the apparent low must be forming over the Himalayas and the Tibet. The reasons for the formation of the low must be the same as before. The uphill currents must give the effect of a low, or the pressure and temperature distribution must both be responsible for the effect on the wind. The reduced barometer readings of Roorkee show a higher pressure than the corresponding values for Dehra Dun on summer afternoons though, in the mornings, the opposite is the case. The stations are chosen near each other so that only diurnal effects are shown up. An analysis may be made to divide the winds into one due to pressure gradient and the other due to the temperature gradient (Thermal winds) after laborious investigations. The picture in this paragraph is simple and can be applied in other similar cases. A confirmation of the above can be seen when there is a western disturbance passing at a more northerly latitude, the afternoon winds in the United Provinces are stronger than usual.

1. *Tech. Note* No. 19, *Indian. Met. Dept.*, 1945. 2. —, No. 20, *Ibid.*, 1945. 3. *Sci. Notes, Indian. Met. Dept.*, 1931, **3**, 131.

*Note.*—The cost of printing this article has been met from a generous grant-in-aid from the Indian Council of Agricultural Research, New Delhi.

# LETTERS TO THE EDITOR



## THE HOTTER THE SUN, THE COOLER THE EARTH

It has been known for a long time that the average temperature of the earth as a whole varies inversely as the frequency of sunspots. Humphreys[1] has expressed this fact by the paradox: "The hotter the sun, the cooler the earth". Although he[2] has indicated an explanation, he[1] concludes that the cause cannot be determined without further observation.

The author[3] has studied the relationship between the average annual sunspot numbers and the pressure distribution in the neighbourhood of South America during April and May. He assumes a sine-curve to represent the normal latitudinal distribution of pressure and finds significant correlation (5 per cent. level) between sunspots and the amplitude of the curve. He finds that *the amplitude of the normal pressure profile in the South Atlantic decreases with increasing sunspots.* Since a strengthening of the meridional circulation should increase the convection and subsidence near the equator and in the horse-latitudes respectively, and hence increase the pressure gradient from the equator to Lat. 30°, a decrease in the amplitude implies a weakening of the meridional circulation. Again, since a decrease in the amplitude of the pressure profile means a decrease in the pressure gradient between the high pressure area at Lat. 30° and the low pressure areas at the equator at Lat. 60°, that also implies a weakening of the westerlies of the higher latitudes and the easterlies of the equatorial zone. But a weakening of the easterlies near equator means an increase in the absolute wind strength in that region. Therefore during sunspot maxima (i) the meridional circulation weakens and (ii) the energy of the atmosphere is increased in the equatorial zone and decreased in the higher latitudes. It could be easily seen that (i) and (ii) are mutually balancing factors in the general atmospheric circulation.

Now, during sunspot maxima the meridional circulation weakens and, therefore, the transport of heat to higher latitudes becomes less. Hence there should be excess of heat in the equatorial zone and less of it in the higher latitudes. This effect is already noticed to co-exist even from a consideration of variation of the amplitude. The excess of heat that should thus be available in the equatorial zone will strengthen the zonal circulation (absolute wind velocity increases) as well as increase convection in the region. The latter will increase the cloud amount and ward off insolation. Thus due to a weakening of the meridional circulation during sunspot maxima, the temperature in the higher latitudes will be reduced and that near the equator cannot increase appreciably. Therefore the average temperature of the earth is reduced.

However, further work has to be done before establishing the relationship between the meridional circulation and the sunspots.

Poona, K. S. Ramamurti.
*December* 30, 1947.

1. Humphreys, W. J., *Physics of the Air*, McGraw Hill Book Co., Inc., New York and London, pp. 619-21, 1940. 2. —, *Astrophys. J.*, 1910, **32**, 97. 3. Ramamurti, K. S., *Indian Sci. Congress*, 1948.

## THE C-C FORCE CONSTANT IN CYCLO-OCTA-TETRAENE ($C_8H_8$)

THE structural formula of this important substance is not definitely known. According to Richter,[1] though its formula seems somewhat similar to the Kekule formula for benzene, it is very unlike benzene and displays a strongly unsaturated and distinctly aliphatic character. Recently Fleet and collaborators[2] have studied the Raman and infra-red spectra and are inclined towards the $D_{2d}$ cradle type structure. On the other hand, Bastiansen and others[3] have also studied the electron diffraction, besides the Raman spectra, and suggest $D_{4d}$ structure with equivalent C-C bonds nearly 2 per cent. greater than those in benzene, and the C-C-C angle of 120°.

Bhagavantam and Venkatarayudu[4] have obtained the frequencies of the $S_8$ molecule which possesses a $D_{4d} = S_{8u}$ structure. Since the structure of the molecule as given by Bastiansen and co-workers[3] is also the same, we have utilized their formulæ for calculating the force constants and the ring frequencies of the molecule. Using the force constant of the C-C bond as $5 \cdot 765 \times 10^5$ dynes and that of C-C-C deformations as $0 \cdot 165 \times 10^{-11}$ dynes, the calculated ring frequencies and the observed ones[3] are as shown (R refers to Raman, and I.R. to infrared frequencies).

TABLE I

*Calculated and Observed Ring Frequencies of Cyclo-Octa-Tetræne*

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Calculated .. | 200 | 880 | 292 | 983 | 166 | 456 | 1148 | 111 | 1456 | 235 |
| Observed .. | 200 (8) | 876 (8) | .. | 944 st. | .. | 370 (6) | 1209 (6) | .. | 1442 (6) | 254 (3) |
| Selection rule | R | R | I.R | I.R | I.R | R | R | R | R | R |

There is fairly good agreement between the observed and the calculated values so far as the Raman spectrum is concerned, and this suggests that the force constants are of the right magnitude.

The force constant 'Ke', the C-C distance 'Re' and the C-C bond order in various carbon compounds are as shown.[5,6]

TABLE II

*The 'Ke', 'Re' and Bond Order of Carbon Compounds*

| | C−C | C=C | C≡C | C−C (Benzene) | C−C (Octa-tetræne) |
|---|---|---|---|---|---|
| 'Ke' .. | 4·0 | 9·5 | 15·6 | 7·5 | $5 \cdot 765 \times 10^5$ |
| 'Re' .. | 1·54 | 1·34 | 1·22 | 1·39 | $1 \cdot 45 \times 10^{-8}$ |
| Bond order .. | 1 | 2 | 3 | 1·66 | 1·3 |
| Dissociation energy | 3·6 | 6·46 | 8·7 | 5·5 | 4·6 ev. |

The C-C distance in cyclo octa-tetræne has been obtained by the use of Allen Longair's relation,[7] $Ke \times Re^6 = C_1$, and the dissociation energy 'D' with the help of Sutherland's relation,[8] $D = c_2\, Ke \times Re^2$. The values of $c_1$ and $c_2$ found with the help of the data (1) to (4) are 53 and 0·38 respect calculated value of the C-C distance, fairly close to the observed value, 1 is also seen that there is an almost tionship between the bond order a sociation energy, and this gives the in octa-tetræne to be 1·3.

The calculated values of the C-C stant and the bond order both indic substance possesses a distinctly ali acter. These calculations also lend the $D_{4d}$ structure suggested by La fuller investigation is in progress.

Department of Physics, B. D
University of Allahabad, HAR
*January* 1, 1948.

1. Richter, *Chemistry of Carbon Compo*
2. Fleet, Cave, Vago, Thompson, *Nat* 739. 3. Bastiansen, Hassel, Langseth 160, 128. 4. Bhagavantam and Venkat *Indian Acad. Sc.*, *A*, 1938, **8**, 101. 5. Slater *to Chemical Physics*, 1939, 433. 6. Hertzb *and Raman Spectra of Polyatomic Molec* 7. Allen and Longair., *Phil. Mag.*, 19 8. Sutherland, G. B. B. M., *Proc. Indian* 1938, **8**, 341.

## ELASTIC CONSTANTS OF AM ALUM

THE elastic constants of ammonium been determined by the wedge m loped in this laboratory, using ult quencies up to about 8 Mc/sec. Th longs to the cubic system, and sect to the (100), (110) and (111) face cut and ground to uniform thickn 1 mm.

In units of $10^{11}$ dynes per cm. sured elastic constants and the cal modulus (K) for this alum, along of potassium and chromium alums earlier by the author.[1] are given I

| No. | Substance | $C_{11}$ | $C_{12}$ |
|---|---|---|---|
| 1 | Ammonium alum | 2·50 | 1·06 |
| 2 | Potassium alum | 2·56 | 1·07 |
| 3 | Chromium alum | 2·37 | 0·93 |

For ammonium alum, the only value available in the literature Bridgman[2] for the bulk modulus. this is 1·542 which is practically ic the value obtained in the present

Department of Physics,
Andhra University, R. V. G. S
Waltair,
*January* 26, 1948.

1. R. V. G. Sundara Rao, *Curr. Sci.*,
2. P. W. Bridgman, *Proc. Amer. Acad.*,

## A NOTE ON THE CHEMICAL EXAMINATION OF NIM BLOSSOMS (*MELIA AZADIRACHTA*)

RESULTS of chemical examination of nim blossoms have been recorded by us in a previous publication.[1] Without making any reference to this work, Subramanian and Rangaswamy in a subsequent communication[2] claimed the separation of certain substances from the blossoms, which are not well defined and some of which appear to form only intermediate stages in the isolation of the various products reported by us. Thus the golden yellow oil reported by them was obviously a crude form of the sesquiterpene derivative. In this communication the isolation of two bitter principles (yield of one, 1·3 per cent.) from the blossoms has been reported. As the blossoms in the Delhi area are not bitter in taste, and no bitter principle was found to be present in any of the fractions derived from the alcoholic extract, it was considered advisable to check up the earlier results by following up the method adopted by Subramanian and Rangaswamy[2] in the working of the blossoms. No bitter principle could, however, be isolated from the blossoms in this area. On the other hand all the products isolated before[1] were identified in this working also.

The alcoholic extract from 2 kilos of the blossoms was repeatedly extracted with ether. From the ether-insoluble fraction, nimbicetin was obtained after acid hydrolysis.[1] The ether solution was then repeatedly extracted with 5 per cent. caustic soda solution. The residue (Ca. 35 gms.) after complete removal of the solvent from the well-washed and dried ether layer, was a thick, brownish, oily liquid with the characteristic pungent smell of the essential oil. It was digested with petroleum ether when a very small quantity of waxy white material was left behind. The petrol ether solution was repeatedly partitioned with 70 per cent. dilute alcohol, when a comparatively small quantity went into the alcoholic layer. The semi-solid, light brown gummy residue (Ca. 1·5 gm.) from the alcoholic layer had the characteristic smell of the essential oil and was not bitter to taste. The acrid pungent taste of the essential oil could, however, be detected with its alcoholic aqueous emulsion. On further digestion with hot petroleum ether, the residue yielded some more steam volatile product from the petrol ether digestive. The residue from petrol ether digestion formed a brownish yellow solid (Ca. 0·06 per cent.) with the smell of essential oil. This residue which would correspond to the bitter, marked "C" by Subramanian and Rangaswamy, was actually not bitter to taste. It was, moreover, optically inactive in contrast to the nimbidine series of bitters isolated from the various parts of the plant.[4] This residue was then subjected to steam distillation when a minute quantity distilled over. The resinous residue was a brittle, light brown solid, sparingly soluble in cold alcohol. It was hydrolysed with 5 per cent. cold alcoholic potash for 20 hours and worked up in the usual manner. Neither the neutral nor the acidic component of the hydrolysates was bitter to taste.

The residue from the petrol ether—a brownish pasty mass with the pungent taste of the essential oil—when distilled with steam, yielded the major fraction of the essential oil (0·3 per cent.). The waxy, solid residue from the distillation had no marked taste, and on saponification with 20 per cent. alcoholic potash gave nimbosterol and nonakosane from the unsaponifiable fraction. The acidic components were not investigated further as the constituent acids had been exhaustively studied.[1]

The alkaline extract from the ether-soluble portion of the original alcoholic extractive was acidified with dilute HCl, and the greyish-brown precipitate filtered off. The aqueous filtrate was distilled, when it yielded the product corresponding to the acidic fraction of the essential oil.[1] The acidic precipitate on repeated purification with solvents, yielded a small quantity of a mixture of fatty acids which were not followed up further in this working.

CHITTARANJAN MITRA.
SALIMUZZAMAN SIDDIQUI.
Chemical Laboratories,
Council of Scientific and Industrial
Research, Delhi,
*January* 2, 1948.

1. Mitra, Rao, Bhattacharya and Siddiqui, *J. Sc. Ind. Res., India*, 1947, **6 B,** 19. 2. Subramanian and Rangaswamy, *Curr. Sci.*, 1947 **16,** 182. 3. Siddiqui and Mitra, *J. Sc. Ind. Res. India*, 1945. **4,** 5. 4. Mitra, Rao and Siddiqui., *Proc. Indian. Sc. Cong.*, 1947 (Adv. Abs. Chem.) **73** a Mitra and Siddiqui, *Ibid*, 1948.

## EFFECT OF SUPPLEMENTATION WITH TAMARIND AND CHILLI ON THE GROWTH OF YOUNG RATS ON A POOR-SOUTH-INDIAN-RICE DIET

ALTHOUGH millions of people have lived for generations, on a poor rice diet composed mainly of rice, the growth response and fertility of rats on experimental diets composed of the same major components have been repeatedly observed to be disappointing.[1–4] This apparent discrepancy is either due to the unsuitability of the rice diet to rats or, possibly, the absence of some supplement which forms a part of the normal human diet, but which is excluded from the experimental diet. A significant omission made in the formulation of the experimental rice diet is with regard to tamarind and chilli, which are invariably added to the rice diet as consumed in South India. As these two ingredients are normally considered to be unimportant in evaluating the food value of experimental diets, it is of interest to determine whether their incorporation would make any difference in the response of the rat to the Poor-South-Indian-Rice-Diet.

Twelve rats from our stock colony were weaned, eighteen days after birth, at the weight of 28 gms., and placed on the rice diet plus 10 c.c. of 10 per cent. Klim milk each till they

weighed about 40 gms. This preliminary procedure has been found to be desirable to accustom the rats to the rice diet. The rats were divided into two groups of six each with equal number of littermates of the same sex. The first group received a poor rice diet of the following percentage composition:

Polished rice, 78·5; tur dal (*Cajanus indicus*) 5·0; common salt, 0·3; non-leafy vegetables, 8·2; leafy vegetables, 2·1; whole milk powder (Klim), 0·9; crude groundnut oil, 5·0.

This diet does not differ materially from the conventional rice diet used by most of the earlier workers. The rice, dal, vegetables and salt were mixed together and cooked with three to four times its volume of water. The crude groundnut oil was mixed with the cooked diet. The milk powder was made into a 10 per cent. solution and fed to the rats separately.

For the second group, the diet was prepared in the typical South Indian style by using tamarind, chilli and extra salt to taste which together made up 2 per cent. of the diet replacing an equal proportion of rice in the above composition. An aqueous extract of the ripe tamarind as prepared in the household and dry chilli powder was used. Extra salt (0·2 per cent.) was also added so as to correspond to the normal diet.

The difference between the two diets in regard to essential constituents (protein, fat, carbohydrate, calcium and phosphorus) is almost negligible.

The growth rate of the animals over a period of 15 weeks are presented in Table I. It was observed that the animals in the second group took slightly longer to get adapted to the tamarind and chilli. The animals receiving tamarind and chilli as supplement were distinctly more active than those on the rice diet alone. In both the groups, there was shedding of hair but this was less pronounced in the tamarind group than in the control. There was no mortality in either of the groups during the experimental period. After that period, the animals were mated. Some of the animals of the tamarind group gave birth to litters, whereas none of the control group has so far done so in spite of over two months of pairing. The related observations will be continued with the succeeding generations.

TABLE I

*Poor Rice Diet*

| Sex | Initial wt. (average) | Final wt. (after 15 weeks) (average) | Average food intake (gm. dry wt.) per day | Average weekly increase gm. |
|---|---|---|---|---|
| M .. | 40·5 | 105·3 | 8·2 | 4·34 |
| F .. | 40·2 | 94·7 | 8·07 | 3·61 |
| Poor rice diet supplemented with tamarind and chilli | | | | |
| M .. | 40·8 | 123·0 | 8·57 | 5·5 |
| F .. | 39·3 | 110·0 | 8·33 | 4·7 |

The average food intake of the rats receiving supplement of tamarind and chilli was only slightly more than that of the animals on the rice diet. The increase in growth of the former was distinctly out of proportion with the extra food intake.

The above is only a *preliminary* note indicating the importance of two food components which had not been considered to be of any nutritional significance. Further work extending the above findings and designed to throw light on the mechanism of action is in progress.

C. R. KRISHNAMURTI.
S. S. DE.
V. SUBRAHMANYAN.

Dept. of Biochemistry,
Indian Institute of Science,
Bangalore,
*January* 2, 1948.

1. Aykroyd *et al.*, *Indian J. Med. Res.*, 1937, **24**, 1093. 2. *Idem*, *Ibid.*, Memoirs No. 132. 3. Eleanor Mason *et al.*, *Ibid.*, 1945, **33**, 219. 4. "Report to the Vanaspati Research Committee," Ministry of Food (unpublished).

## FACTORS AFFECTING THE NUTRITIVE VALUE OF SOYA BEAN PROTEIN

IT is now well known that the nutritive value of soya bean protein which is low in the raw state is appreciably raised by suitable heat treatment.[1–5] Johnson *et al.*[6] attribute this difference in nutritive value to the presence of a nitrogen-sulphur complex in the raw protein which, they believe, cannot be utilised and that heat treatment makes it available for tissue-building purposes. This has also been confirmed by later work.

Recently Ham *et al.*[7–8] found that a trypsin inhibitor in the raw bean interferes with the utilisation of protein. Melnick *et al.*[9] have also suggested the mechanism for the action of this inhibitor. Experiments carried out in this laboratory have led to the following interesting findings with regard to the role of the trypsin inhibitor and other possible factors affecting the nutritive value of soya bean protein.

(1) The removal of the tryptic inhibitor by acid extraction of raw soya bean meal raises the growth-promoting value of the protein from 1·2 to 1·4, while autoclaving raises the value to 1·9.

(2) The tryptic inhibitor being heat-labile, all types of heat treatment must be expected to increase the nutritive value of the protein to about the same extent; but only wet heating and particularly autoclaving has been found to have a beneficial effect on the nutritive value.

(3) Germination of the soya bean increases the nutritive value of the protein; but the concentration of the tryptic inhibitors in the raw and the germinated beans remains the same.

The above evidence, as also the observations made by Riesen *et al.*[10] on the digestibility of

heat-treated soya bean meal would lead to the conclusion that, apart from the tryptic inhibitor, there are other factors which modify the nutritive value of soya bean protein.

There was the possibility of the existence in raw soya beans of toxic substances acting as anti-growth factors and which are destroyed by heat. The experiments of Osborne *et al.*[11] and Hayward[5] showed that raw soya bean did not contain any toxic factor soluble in fat solvents. Experiments were carried out in this laboratory to see whether the saponins or other water-soluble factors present in soya bean acted as toxic factors, but it was found that extraction with 70 per cent. alcohol or dialysis of the soya bean meal did not raise the growth-promoting value of the protein. These results lead to the conclusion that it is rather unlikely that soya bean would contain any toxic or growth-retarding factors.

The probable explanation that can be provisionally offered for the increase in nutritive value of soya bean protein by heat treatment is, therefore, in terms of a structural alteration of the protein. The experiments of Julian *et al.*[12] have led them to a similar conclusion.

The author's thanks are due to Prof. V. Subrahmanyan and Dr. S. S. De for their kind interest in the work.

Department of Biochemistry,
Indian Institute of Science,
Bangalore, H. S. R. DESIKACHAR.
*January* 13, 1948.

1. Osborne, T. B., & Mendel, L. B., *Jour. Biol Chem.*, 1917, **32**, 369. 2. Vestal, C. M., and Shrewsbury, C. K., *Ind. Ed. Proc. Am. Soc. Animal Prodn.*, 1933. 3. Shrewsbury, C. L., Vestal, C. M., & Hauge, S. M., *Jour. Agr. Res.*, 1932, **44**, 267. 4. Robinson, W. L., *Ohio Agr. Exp. Sta. Bull.*, 1930, 452. 5. Hayward, J. W., Steenbock, H., and Bohstedt, G., *Jour. Nut.*, 1936, **11**, 219. 6. Johnson, M., Steenbock, H. & Parsons H T., *Wisc., Agr. Expt. Sta. Bull.*, 1937, 438. 7. Ham, W. E., and Sandstedt, R. M., *Jour. Biol. Chem.*, 1944, **154**, 505. 8. Ham, W. E., Sandstedt. R. M., and Mussehl, *Ibid.*, 1945, **161**, 327. 9. Melnick, D., Oser, B. L., and Weiss., *Science*, 1946, **103**, 327. 10. Riesen, W. H., Clandinin, D. R., Elvehjem, C. A., and Cravens, W. W., *Jour. Biol. Chem*, 1947, **167**, 143. 11. Osborne, T. B. and Mendel, L. B., *Proc. Soc. Exp. Biol and Med.*, 1917, **14**, 174. 12. Julian, P. L., *The Baker's Digest.*, 1943, **17**, 19.

## STUDIES IN ANTIMALARIALS SOME N[1]-(8-QUINOLYL)-N[5]-PHENYL-BIGUANIDES

ANTIMALARIALS of the amino-quinoline series[1,2,3] have been attaining great importance in view of their value in treating the various types of malaria. Plasmochin,[4] Pentaquin,[2] Aralen[5], all derivatives of amino-quinoline, exert definite curative and prophylactic action against malaria. Plasmochin, however, suffers from the disadvantage of being excessively toxic.[6]

In an effort to find out a better antimalarial, innumerable derivatives of amino-quinoline are, now-a-days, being prepared and their activity against malaria studied. The quest for an ideal antimalarial by Curd and Rose and their collaborators[7] resulted in the discovery of 'Paludrine',[8] a biguanide derivative, which is the least toxic and most potent of all existing antimalarials. With a view to combining the beneficial qualities of both these types of compounds, several derivatives of the quinolyl-biguanide, type (I), have now been synthesised.

The compounds were obtained by condensing 8-amino-quinoline hydrochloride with the appropriate aryl-cyano-guanidine in alcoholic or dioxane medium by refluxing for 8-12 hours. After treatment of the reaction mixture with dilute alkali solution the base was separated and purified. The hydrochloride or the acetate, as the case may be, of the base was prepared and characterised. While the hydrochlorides contain either two or three molecules of hydrochloric acid and one or two molecules of water of crystallisation, the acetates contain only one molecule of acetic acid and no water of crystallisation.

The compounds and their physical properties are given in Table I.

Type I

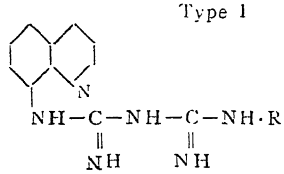


TABLE I
N[1]-(8-Quinolyl)-N[5]-R-biguanides

| No. | R | M.P. of base °C. | Salt | M.P. of salt °C. |
|---|---|---|---|---|
| 1 | Phenyl- | 190(d) | $3HCl, H_2O$ | 183(d) |
| 2 | *p*-Tolyl- | 190–91(d) | $2HCl, H_2O$ | 196(d) |
| 3 | *p*-Anisyl- | 179(d) | $3HCl, H_2O$ | 168(d) |
| 4 | *p*-$NO_2$-phenyl- | 188–89(d) | $2HCl, 2H_2O$ | 238(d) |
| 5 | *p*-AcNH-phenyl- | 250(d) | $CH_3COOH$ | 237–38(d) |
| 6 | *p*-$NH_2$-phenyl- | | $CH_3COOH$ | 151–52 |
| 7 | *p*-Cl-phenyl- | 191–92(d) | $CH_3COOH$ | 204–205(d) |
| 8 | *p*-Br-phenyl- | 204–205(d) | $CH_3COOH$ | 212–13(d) |
| 9 | *p*-I-phenyl- | 239(d) | $CH_3COOH$ | 213–14(d) |

Full details will be published elsewhere.

Our grateful thanks are due to the Lady Tata Memorial Trust for the award of a scholarship to one of us (P.R.G.).

P. R. GUPTA.
B. H. IYER.
P. C. GUHA.

Organic Chemistry Laboratories,
Dept. of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore,
*January* 20, 1948.

1. Magidson, O. Y., *et al.*, *J. Gen. Chem.*, *U. S. S. R.*, 1938 **8**, 899. 2. Drake, N. L., *et al.*, *J. A. C. S.*, 1946, **68**, 1529. 3. Norton, T. R., *et al.*, *Ibid.*, 1946, **68**, 1572. 4. Schuleman, *et al.*, *Klin. Wchnscher*, 1932, **11**, 381. 5. Drake. N. L., *et al.*, *J. A. C. S.*, 1946, **68**, 1208. 6. Elderfield, R. C., *et al.*, *ibid.*, 1946, **68** 1524. 7. Curd, F. H. S., *et al.*, *J. C. S.*, 1946, 343–84. 8. —, *ibid.*, 1946, 729.

## ASCORBIC ACID AND GLUTATHIONE CONTENT IN (HUMAN) BREAST CANCER TISSUE

A NUMBER of workers[1-4] have studied the mineral content of cancerous tissue. Investigations on the vitamin content, however, are still meagre. Picard and Marsden[5] showed that glutathione content was high in breast cancer but was not significantly so in recurrent cancer. The present note deals with the vitamin C and glutathione content in human breast cancer tissue.

Human breast tissues were obtained from patients suffering from cancer of the breast and undergoing a surgical treatment. The estimations were carried out within half an hour after excision of the tissue. The healthy tumour tissue was selected as far as possible free from necrotic areas and hemorrhage within the body of the tissue, while the normal portion was obtained from the adjoining part of the same breast. In doubtful cases the condition of the normal tissue was confirmed by histological examination. The tissue was carefully dissected and the adhering fat globules were removed. Each of the two tissues was gently pressed between filter-papers, and about one gram sample of each was accurately weighed and used for the determinations of ascorbic acid and glutathione by methods of Mindlin and Butler[6] and Woodward and Fry[7] respectively. The estimations were carried out in thirty samples of breast tissue, each of which afforded both a normal and a tumour portion for the investigation. The averages of the results are shown in the following table.

TABLE I

*Mean Ascorbic Acid and Glutathione in Normal and Tumour Tissue of Human Breast (mgms. per cent.)*

| Breast Tissue | Ascorbic Acid | Glutathione |
|---|---|---|
| Normal .. | 9·14 ± 1·10 | 24·09 ± 4·15 |
| Cancer .. | 14·90 ± 1·60 | 63·51 ± 7·06 |

The statistical treatment of the data by the application of "Students' *t*-test," showed the differences of ascorbic acid and glutathione contents in normal and tumour tissues as significant, and the chance of such a happening at random is less than 1 in 1,000.

These observations on human breast tissues demonstrate that the metabolic processes of cancerous tissue of human breast are probably different from those proceeding in the normal part of the same breast tissue, and the higher concentrations of ascorbic acid and glutathione in tumour tissues are probably concerned in the processes of malignant growth.

Physiology Department,
Seth G.S. Medical College,
Parel, Bombay, R. G. CHITRE.
and
Tata Memorial Hospital,
Parel, Bombay, N. G. JOSHI.
December 20, 1947.

1. Brunschwig, A., Dunham, L. J., & Nichols, *Cancer Res.*, 1946, **6**, 230. 2. Dunham, L. J., Nichols and Brunschwig, A., *Ibid.*, 1946, **6**, 233. 3. Stowell, R. E., and Cooper, Z. K., *Ibid.*, 1945, **5**, 295. 4. Buchwald K.W., and L. Hudson, *Ibid.*, 1944, **4**, 645. 5. Picard R. J., and Marsden, C S., *J. lab. Chem. Med.*, 1934, **19**, 395. 6. Mindlin, R. L, and Butler, A. M., *J. Biol. Chem.*, 1938, **122**, 672. 7. Woodward, G. E. and Fry, E. G., *Ibid.*, 1932, **97**, 465.

## INDIAN WILD CHERRY BARK

WILD Cherry bark is the bark of *Prunus serotint* Ehrhart (family Rosaceæ), collected in autumn, when it is most abundant, and carefully dried and stored. The tree grows wild in North America, and most of the bark of commerce comes from Virginia, Indiana, North Carolina and Michigan.

The drug is popularly employed to relieve cough in Phthisis and bronchitis of various types. The mildly sedative properties of the drug is generally attributed to the small quantity of the hydrocyanic acid present.

*Prunus serotina* is not indigenous to India, but there are several species of Prunus which are either cultivated for their fruits or grow wild in India. An attempt was made to investigate if any of these species could form a good substitute for the official bark used for medicinal preparations.

The barks of *Prunus amygdalus* Baily (Vernacular Badam), *P. avium* Linn. (Ver. Gilas), *P. armeniaca* Linn. (Ver. Khubani), *P. communis* Huds. (Ver. Alubukhara), *P. persica* Benth. (Ver. Aru), *P. padus* Linn. (Ver. Bharat), *P. cerasus* Linn. (Ver. Jangali gilas) were analysed.

The last two species grow wild at 5,000 to 7,000 ft. above sea-level, while the other species are cultivated extensively in the Kashmir valley for their fruits. Various parts of the plants of the above-mentioned species are generally used in the indigenous system of medicine.

The bark was collected from the stem and branches in the autumn season, dried and analysed. The results are tabulated below.

TABLE I

*Analysis of Indian Wild Cherry Bark*

| Name of species | % of total ash | Acid insoluble ash % | Alcohol extractive with 60% alcohol (B.P. Method | Hydrocyanic acid % |
|---|---|---|---|---|
| *Prunus amygdalus* | 19·5 | 2·2 | 13·2 | 0·0022 |
| *Prunus avium* .. | 6·3 | 0·94 | 14·2 | |
| *P. armeniaca* .. | 7·9 | 0·96 | 18·4 | |
| *P. communis* .. | 7·4 | 1·9 | 19·2 | ·0043 |
| *P. padus* .. | 10·6 | 0·96 | 21·1 | |
| *P. persica* .. | 6·1 | 2·4 | 28·8 | 0·015 |
| *P. cerasus* .. | 3·6 | 0·31 | 18·1 | traces |
| *P. serotina* B.P.C. standards | 3 to 4 | 0·2 to 0·6 | 17 to 23 | 0·075 to 0·16 |

The results show that with regard to the HCN content none of the barks of the locally growing species of Prunus comes up to the standards laid down for the official drug. Attempts are, however, being made to cultivate *Prunus serotina*, on an experimental basis, as the requisite climatic conditions are available.

We are grateful to Col. Sir Ram Nath Chopra for his valuable guidance in the course of this investigation.

Drug Research Laboratory, Jammu Tawi, L. D. KAPOOR.
K. L. HANDA.
*January* 19, 1948.

## AUTOTETRAPLOIDY AND ATTENUATING POWER IN YEASTS

INDUCTION of polyploidy has been claimed to be an important method for the improvement of crop plants. Duplication of the chromosome complement is followed in some cases by characteristic changes in the biochemical behaviour. Rowson[1,2] has shown that autotetraploids have a higher alkaloid content than the diploids. Randolph and Hand[3,4] give quantitative data on the carotenoid content and vitamin A activity of diploid and autotetraploid corns.

Little work on similar lines has, however, been reported in the case of yeast and fungi for the simple reason that the chromosome constitution of most of the strains are unknown. Conflicting reports have been published recently on induction of polyploidy in *P. notatum*[5,6] as well as its relation to penicillin production.

In this laboratory two strains of beer yeasts of known chromosomal constitution are available. The tetraploid strain, BY 3, was obtained by treating the original diploid, BY 1, with acenaphthene.[7,8] This tetraploid has been constantly under observation for the past two years. The vitaminic requirements of the diploid and tetraploid strains were shown to be similar,[9] but their rates of growth are different.[10] It was thought, therefore, that a comparative study of the attenuating power of the two strains would be interesting. An extensive series of experiments with varying sugar concentrations (16 per cent. to 40 per cent.) and yeast inocula have been carried out. A representative set of results is presented below.

The inocula for the fermentation trials were built up by growing the strains in wort with vigorous aeration. In each case a 24 hour culture in wort was centrifuged, washed and resuspended in saline under sterile conditions to be used as the "pitch". Equal amounts of the two strains on the moist weight basis were then inoculated in sugar solutions contained in 100 ml. flasks. 25 ml. of the fermenting mixture after inoculation contained sucrose 6 gms., $KH_2PO_4$ 0·4 gm., $(NH_4)_2SO_4$ 0·4 gm., and yeast 1·2 gm. (moist weight).

In each case the rate of attenuation was determined by noting the specific gravity of the fermenting mixture at intervals by means of a Westphal specific gravity balance. Alcohol percentages were calculated from the attenuation data and the results have been graphically represented in Fig. 1.

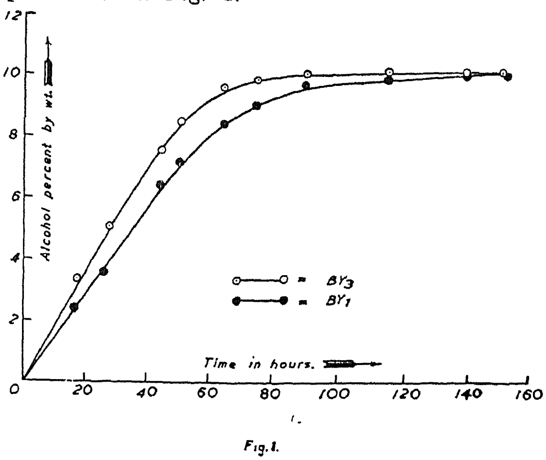



FIG. 1

It will be seen from the figure that the rate of attenuation is much faster in the case of the tetraploid strain. A careful study of the graph reveals that at any stage of fermentation the rate of alcohol production is approximately 30 per cent. faster than that by the diploid. The quickening in the rate of attenuation does not, however, reflect itself in the final yields of alcohol. The final concentration of alcohol in the media is the same in both cases although the limit is reached much earlier in the case of the tetraploid.

It appears that duplication of the chromosome complement in yeasts leads to an increase in vigour in that not only is there an acceleration of the rate of growth but also a quickening of the rate of attenuation.

I am very grateful to Sir J. C. Ghosh, KT., D.SC., F.N.I., for his active interest and encouragement, to Dr. M. K. Subramaniam for the cultures and a discussion of the results, and to the Council of Scientific and Industrial Research for generous financial assistance.

Dept. of General Chemistry,
Indian Institute of Science,
Bangalore, S. India, K. K. MITRA.
*November* 24, 1947.

1. Rowson, J. M., *Quart. Pharm. Pharmacol.*, 1945, **18**, 175–84. 2. —, *Nature*, 1944, **154**, 81–82. 3. Randolph, L. F., and Hand, *J. Agr. Res.*, 1941, **60**, 57–64. 4. —, *Science*, 1938, **87**, 442–3. 5. Sansome, E. R., and L. Banner, *Lancet*, 1946, **250**, 828–9. 6. Gordon, W. W., and J. A. Mac., *Ibid.*, 1945, **248**, 47. 7. Subramaniam, M. K., *Proc. Nat. Inst. Sci.* (*India*), 1946, **12**, 143. 8. —, *Ibid.*, 1947, **13**, 131. 9. Prema Bai, M., *Curr. Sci.*, 1947, **16**, 317. 10. Prema Bai, M., and M. K. Subramaniam, *Ibid.*, 1947, **16**, 380.

## 'RAYUNGAN' METHOD FOR SPEEDY MULTIPLICATION OF SEED MATERIAL IN SUGARCANE

EXPERIMENTAL stations are often faced with the difficulty of shortage of seed material of the new varieties which they receive from outside

or those that evolve themselves out of their selections. It often takes three to four years before one could get enough seed material for including the seedling in a properly randomised field-scale experiment. To expedite the multiplication of the seed material, 'Rayungan' method as described by Dillewijn[1] has been tried with slight modifications at Shahjahanpur. The method offers a much better scope for raising larger quantities of seed material than is possible by the ordinary method of multiplication, and consists of germinating the buds on the standing cane prior to planting in the field. To induce shooting in the buds the cane is topped, four to six weeks before the time of planting, with a sharp field knife of *hansia* (scythe). The topping cut is made in a slant in one stroke at a point as far as the millable cane is formed. The cane is then stripped off the leaves. The crop after topping is given a light dressing of ammonium sulphate, say, at the rate of 20 lb. nitrogen per acre and irrigated once or twice only. As soon as the buds grow into sufficiently developed shoots, called 'rayungans', 4 to 6 inches long, the cane is cut into one-budded setts which are planted in trenches previously prepared and manured. In handling the 'rayungans' much care is necessary to avoid damage, mainly due to their breaking at the base near the attachment with the sett. The leaves of the 'rayungans' are partly clipped off before planting in the soil to reduce transpiration. An irrigation is given immediately after planting. Frequent but light irrigations are subsequently given till the seedlings take root, and later, as with the normal plantings.

This method ensures germination and gives a greater amount of success as compared with the normal method of planting setts in the soil, in which, in spite of a rigorous selection of buds and provision of optimum conditions for planting, the germination (under Shahjahanpur conditions) seldom exceeds 30 to 50 per cent.[2]

The results of a field trial comparing the two methods are given below. The cane in this case was topped in the first week of April and planted in the first week of May 1947. The variety used was CoS. 186.

TABLE I

| Method | No. of buds Planted | No. of shoots established | No. of millable canes on 30–9–47 |
|---|---|---|---|
| New .. | 80 | 69 | 221 |
| Normal (Old) | 80 | 33 | 115 |

The difference between the two methods as given above is very significant inasmuch as the germination and the subsequent amount of seed material (as judged by the number of millable canes) available are almost twice that secured with the normal method of planting.

It was also observed that the canes with the new method of planting were taller, thicker and healthier in look, due to the earlier establishment of shoots than is secured from the normally planted canes. This method has also the possibility of being adopted for late plantings in which normally a good stand is seldom achieved.

Further experimentation in this connection is in progress.

B. K. MUKERJI.
RAM KRISHAN.

Main Sugarcane Research Station,
Shahjahanpur (U.P.),
*January* 19, 1948.

1. Dillewijn, Ir. C. Van, *Bulletin of the Sugarcane Expert. Istanbul* (1947). 2. Singh, S. B., and Krishan, R., *Proc. Sugar Tech. Association, India* (1946).

## OCCURRENCE OF *MYROTHECIUM RORIDUM* TODE EX FRIES ON COW-PEA IN INDIA

IN September 1945 and 1946, a leaf-spot disease was noticed on cowpea, *Vigna unguiculata* (Linn.) Walp. in Krishnanagar, Bengal. The fungus associated with the disease was identified as *Myrothecium roridum* Tode ex Fries. The genus *Myrothecium* has not been recorded in India.

*Symptoms*—The leaf-spots begin as minute, brownish dots, 1-2 mm. in diameter, having a raised margin, slightly pinkish violet in colour and a depressed centre, which is brown, thin and translucent. When the fungus invades the surrounding tissue a second zone is formed around the original spot. In the second zone also the thin and translucent brownish area is surrounded by the raised margin of a pinkish colour. Sometimes two or three such thin central areas have a common coalescing outer zone. The diameter of the inner and outer areas vary widely from a few millimetres to 2·5 cm. or more.

*Morphology of the fungus*—The sporodochia are produced on the dorsal surface of the laminæ in the thinner zones of the spots. At first small islands of white, woolly, pseudoparenchymatous stromata, about 1 mm. in diameter arise. These stromata are composed of the intertwining conidiophores. The spores are produced from a closely packed hymenium-like layer of phialides. The spores remain aggregated together forming a jet black, viscid mass. Several of these sporodochia are produced in a circle in the spots and the spore masses merge with one another forming a more or less continuous irregular black circle.

The conidia are cylindrical or slightly tapering with rounded ends, continuous, 2 guttulate, hyaline at first, becoming pale green with a prominent black wall, measuring $10\,\mu \times 3\,\mu$ on the average.

Preston[1] studied the genus, *Myrothecium* and its three classic species, *M. inundatum* Tode ex Fr., *M. roridum* Tode ex Fr., *M. verrucaria* (Alb. and Schewein) Ditmar ex. Fr., and has published emended descriptions of the same.

The fungus has been reported from England on *Viola tricolor*, *Antirrhinum majus*, *Lycopersicum esculentum*; from Sierra Leone, West Africa, on *Hibiscus esculentes*, *Dolichos lablab*,

*Trichosanthes*, and *Asclepias* sp.[1]; and from California on *Gardenia*.[2] It will be observed that the above list includes well known Indian cultivated vegeteables and garden plants, on none of which the fungus has so far been reported from this country.

The specimens have been deposited at the Imperial Mycological Institute, Kew, Surrey, England.

The author is indebted to Dr. E. W. Mason of the Imperial Mycological Institute, Kew, Surrey, for identifying the fungus.

Central Rice Research Institute,
Cuttack, S. Y. PADMANABHAN.
*January* 9, 1948.

1. Preston, N. C., *Trans. Brit. Mycol. Soc.*, 1943, **26**, 158. 2. Barrel, J. T., and Doris Ann. Hardman, *Phytopath.*, 1947, **37**, 360.

## ENATION MOSAIC OF *DOLICHOS LABLAB* LINN., A NEW VIRUS DISEASE

IN August 1939 a mosaic disease accompanied by chlorotic streaks was observed in *Dolichos lablab* grown on the Agricultural College Farm, Poona. The disease reoccurred on the farm for three consecutive seasons, but was observed only occasionally afterwards. It has not been found to occur in other localities of this province.

The first symptoms of mosaic appear in young leaves of *Dolichos lablab* about twenty days following inoculation under controlled conditions with sap expressed from diseased plants. Subsequent leaves show severe mosaic accompanied with chlorotic streaks (Fig. 1). The

FIG. 1. Leaf of *Dolichos lablab* affected by enation mosaic virus.

leaves of affected plants are malformed and produce foliar enations on their undersides (Fig. 2). There is also a marked reduction in size of leaf-lamina due to inhibition of growth of the interveinal areas.

FIG. 2 Leaflet of *Dolichos lablab* showing large foliar enations as a result of infection with enation mosaic virus.

*Transmission*.—The virus is readily transmitted by sap inoculation. But transmission tests done with *Empoasca devastans* Dist., *Empoasca* sp., *Aphis medicaginis* K., *Aygaria chætophora* K., *Tæniothrips distalis* K., the insects which colonise on *Dolichos lablab*, and *Aphis gossypii* Glover collected from cotton plants unsuccessful.

The dilution end-point of the virus in crude sap lies between $5 \times 10^{-6}$ and $3 \times 10^{-6}$. It can withstand heating for 10 minutes at 90° C., but is inactivated at 95° C. The virus was still active after six years at laboratory temperature.

The virus has a wide host range. Besides *Dolichos lablab*, it infects a large number of

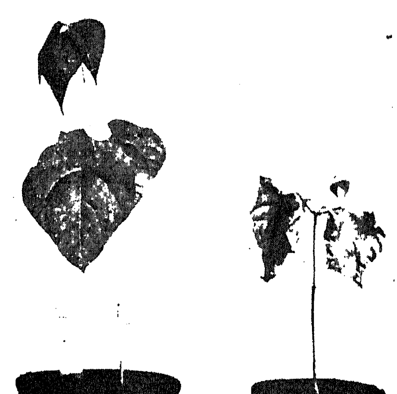


FIG. 3. Healthy and diseased plants of *Phaseolus vulgaris*. The affected plant shows systemic necrosis,

leguminous plants. In *Phaseolus vulgaris* it induces systemic necrosis which kills the whole plant (Fig. 3). In *Nicotiana tabacum*, variety White Burley, it produces primary lesions which appear as thin, white rings of necrotic tissue enclosing green areas, and the disease, on becoming systemic, appears as mosaic mottling after about 65 days following inoculation. The virus does not infect *Cucumis sativus*, *Datura alba* and a large number of other plants.

Although the physical properties of *Dolichos* virus closely resemble those of the tobacco mosaic virus,[1] it markedly differs from the latter in respect of its host range and in the type of symptoms produced in tobacco itself. In addition, the cross immunity tests carried out with the two viruses in *Nicotiana tabacum*, variety White Burley, indicated that neither of the two viruses protects tobacco plants from infection with the other. The *Dolichos* virus is, therefore, not related to the tobacco mosaic virus.

The *Dolichos* virus has no relationship with any of the legume viruses,[1] except that its thermal inactivation point approximates to those of the Bean viruses 4 and 4A[2], and its dilution end-point is as low as that of the Pea Streak virus.[3] It is proposed that this new virus may be known as '*Dolichos enation mosaic*' virus.

Sincere thanks are due to Dr. B. N. Uppal under whose guidance this work has been done. This investigation is being carried out under a scheme financed by the Indian Council of Agricultural Research.

College of Agriculture, Poona, S. P. CAPOOR.
P. M. VARMA.
*January* 15, 1948

1. Smith, K. M., "A Text-Book of Plant Virus Diseases", London, 1937. 2. Zaumeyer, W. J., and Harter, L. L., *J. Agric. Res.* 1943, **67,** 305. 3. Chamberlain, E. E., *New. Zealand. J. Sci. and Tech.*, 1939, **20,** 381A (in *Rev. Appl. Mycol.*, 1939, **18,** 648).

## PENAEID PRAWNS BREEDING IN FRESH WATER

IN a recent note in *Current Science* on the migratory fishes of the inland waters of Madras, Chacko[1] states that berried individuals of four prawns, namely, *Palæmon malcolmsoni* Milne-Edwards, *Palæmon scabriculus* Heller, *Penæus indicus* Milne-Edwards and *Metapenæus monoceros* Fabr. were found in the Godavari river both above and below the anicut. On the basis of this it is presumed by this author that these prawns breed in the river.

As Penæid prawns are well known to hatch out as naupalii, and the adult females of *Penæus* spp., and *Metapenæus monoceros* are not known to carry eggs attached to the abdominal pleopods[2] it is most unusual if *berried* individuals of *P. indicus* Milne-Edwards and *M. monoceros* Fabr., have been observed. All available evidence is that in the Penæid prawns the eggs are shed in the surrounding water.[3] What seems probable is that there has been some confusion in regard to the species dealt with by Chacko, and it appears to me that the berried prawns seen near the Godavari anicut could not have been Penæids but only Caridian prawns, probably Palæmonids. The statement that *P. indicus* breeds in inland waters at a distance of 100 miles from the sea has also to be re-examined and, if confirmed, it is in substantial disagreement with our knowledge of this species. But as this is based on the occurrence of so-called berried specimens of *Penæus* spp., it need not be taken seriously.

It may be added that recent experiments which I have carried out indicate that the Penæid, most tolerant to fresh water, is *M. monoceros*. This species probably breeds in coastal zones not directly connected with the sea as found from Dakin's results in Australia and the observations made at Madras.[4] Of the other two Penæids of commercial importance on Coromandel coast, *viz.*, *P. carinatus* and *P. indicus*, the one less tolerant to low salinity is *P. indicus*. The field data at Madras, the Collair Lake and at the Chilka Lake are also in agreement with this experimental result.

Central Marine Fisheries Research Station, Triplicane, Madras, N. KESAVA PANIKKAR.
*January* 29, 1948.

1. Chacko, P. I., *Curr. Sci.*, 1947, **16,** 290. 2. Dakin, W. J., *Nature*, 1947, **158,** 99. (Most of the early references are cited by Dakin.) 3. Gurney, R., "Larvae of Decapod Crustacea," *Ray. Soc.*, 1942. 4. Panikkar, N. K. and Aiyar, *R. G. Proc. Indian Acad. Sci.*, B, 1939, **9,** 343.

## PHOTOSENSITIVE GLASS

Glass exposed for years to light and heat has been observed to change its colour. Based on this observation, researches have been carried out at the Corning Glass Works of U.S.A. Reactions taking place in crystal-clear ruby glass on application of ultra-violet light and heat treatment gives rise to several shades of colour. A photosensitive glass has now been developed in which pictures may be printed with a three-dimensional effect, caused by depth of image penetration, and with a variety of colours and extremely fine detail.

The light-sensitive ingredients are mixed into the batch before melting and, therefore, form an integral part of the glass. Prints are made, first by exposure to ultra-violet light and then, in an oven, to a temperature of 1,000°-1,100° F. After baking for half an hour a picture is formed with coloured particles so fine that they cannot be seen under a microscope. Photographic designs in blue, purple, ruby or orange is said to be possible with transparent glasses,

# REVIEWS

**New Developments in Ferromagnetic Materials.** By J. L. Snoek. (Elsevier, Distributors: Cleaver Hume Press, Ltd., 42-A, South Audley Street, W. 1, London), 1947. Pp. 136 + viii. Price 13*sh.* 6*d.*

The book is one of a series of monographs on the Progress of Research in Holland. The purpose of these publications is, according to the Foreword, "to show to the world that scientists in the Netherlands have remained active during the five years of German occupation". The monograph under review is a connected report on the various original investigations on Ferromagnetism carried out during those five years, and would be of great interest to those who are actively engaged in research in these fields. The results reported indicate the praiseworthy co-ordination that has existed between the theoretical and the practical research workers in Holland.

The book is made up of three chapters, the first two dealing with the statics and dynamics of ferromagnetism and the third with the development of new magnetic materials. The first part contains the various consequences of Kersten's extension of the theory of ferromagnetic hysteresis, which is based on the concept of crystal anisotropy and magnetostriction. One of the many results that follow from this theory is that a substance is expected to have a very high value of the initial permeability and a low value of the coercive force if its crystal anisotropy and magnetostriction are both zero. By a careful survey of such "zero points" in binary and ternary alloys, F.C. Went has discovered a new alloy of the permalloy type. The first chapter also contains some experimental discoveries which show that the present theories of ferromagnetism are quite inadequate. Of particular interest is the one in which it is found that crystals of magnetite develop a strong ferromagnetic anisotropy below 114°·5 K. although the ionic lattice does not undergo any change of symmetry.

The second chapter deals with researches on the magnetic skin effect, and on the various forms of "after-effects", such as magnetic, elastic and ionic, and the time decrease of permeability, very aptly called Dis-accommodation by the author.

The last chapter describes the preparation and the study of the properties of a series of new non-metallic ferromagnetic substances. These substances are produced by appropriately mixing different chemical compounds which go by the name of ferrites. These ferrites have a general formula MO, $Fe_2O_3$ (where M is a bivalent element) and have the well-known spinal structure. The resulting mixture, commercially known as "Ferroxcube", is a mixed crystal having the same crystal structure. These new magnetic materials are easily workable by grinding and lapping and have a very high specific resistance while the "joints" show very low magnetic resistance. Four different types of materials have been described and their usefulness in most varied purposes involving high frequencies have been proved.

The book contains five appendices, three of which are reprints of papers published in different European Journals.

S. RAMASESHAN.

**Why Smash Atoms?** By A. K. Solomon. (Penguin Books, Harmondsworth, Middlesex, England.) Pp. 160.

This is the popular edition of a book that was first published in America in 1940. In keeping with the object of popularising the latest advances in science, the fascinating story of the atom and its breaking has been presented here for the layman. The narration assumes very little on the part of the reader and thereby gains in lucidity.

Beginning with the historic experiments of of Benjamin Franklin, the fundamentals are logically developed through the discovery and the definition of the electrons, the canal rays and the neutrons. The discovery of radioactivity and the experiments thereon of Rutherford leading to the elucidation of the common structure of atoms are then described. Further clarification and formulation of the atomic structure by Bhor, and the discovery of isotopes by Moseley make fascinating reading.

The story of atom-smashing, beginning with natural radiations, by Rutherford, and then with accelerated particles are described with convincing detail. Numerous diagrams and photographs sprinkled throughout the book help immensely in the comprehension of the subject. But the most important section of the book, to the layman, is "why bother smash the atom?" The consequences of the preceding fundamental researches, in war and peace, are clearly brought out in the III Part. The discovery of induced radio-activity, and the production of radioactive elements on a mass-scale with their enormous usefulness in Medicine and Biology greatly impress the reader, and convinces him that scientists have not, after all, gone mad, and that basic researches are essential for application to human welfare.

In this age of democracy, the importance of the correct appreciation of the fundamental discoveries of science by the man in the street cannot be overestimated, for the "effective application of scientific improvements requires a thorough popular understanding of scientific discoveries". The publishers have eminently succeeded in popularising a scientific subject of first rate importance.

In India it would be a great step forward if such popular publications are retold in Indian languages for the benefit of the masses who have a great leaway to make up in their knowledge of progress of the rest of the world through the application of science before they can effectively co-operate with the government in national development.

In the next edition of the volume such statements like, "An alpha particle—a doubly charged helium *atom*" (p. 36), may be avoided without sacrifice of lucidity.

K. S. R.

**The Machinists' and Draftsmen's Handbook.** By Albert M. Wagener, M.E., and Harlan R. Arthur, B.S. (Messrs. Macmillan & Co., Ltd., London), 1946. Pp. 662. Price 28*sh.* net.

Engineering handbooks are generally written either elaborately or in a condensed form with the result that the information required is too tedious to get at or difficult to understand without sufficient knowledge of fundamentals. *The Machinists' and Draftsmen's Handbook* is written with a view to eliminating this drawback. As stated in the preface of this book, "most men in the craft have studied mathematics but it is very quickly forgotten by the majority of them". So, this book starts with elementary mathematics and simple geometric constructions which are essential for making and setting out jobs.

The second part of the book deals with modern machine tools, speeds, feeds, limits and tolerances which are important for modern mass production and from the point of view of interchangeability of parts. Due importance is also given to the various milling operations and the chapter on milling is thorough and exhaustive.

The last part of the book is on strength of engineering materials thus giving the operator an idea of the right type of material to be used in the right place. There are a number of useful tables for ready reference, and the book is quite useful to the machinist in his day-to-day work.

But, from the point of view of a draftsman this book is a little disappointing.. The draftsman can no doubt use the information given in it, but he needs a lot more for working in an engineering drawing office. For example, the principles of drafting or the various drafting conventions to be used on a working drawing are nowhere mentioned in the book. So the book would have justified the title if it had been "Machinists' Handbook". However, the book is quite useful not only to the machinists working in the shops, but also to the student in a trade school where the machinist trade is taught.

M. R. K. RAO.

**Statistical Year-Book of the League of Nations,** Geneva, 1942-44. 17th issue. Edited by M. Grzegorz Frumkin of the Economic Financial and Transit Department, 1945. Pp. 315, and 108 tables.

This is a valuable document giving all available information regarding population and vital statistics, movement of population, unemployment, production—agricultural, mineral and industrial—trade, prices, currency and banking statistics and public finance for 44 countries of the world for the years 1942-44 on the eve of the formation of the U.N.O. This publication was issued when the second World War was in progress; and so, numerous difficulties of communications and restrictions had to be faced and hence the delay in the issuing of the year-book. A number of belligerent or neutral countries had suspended publications of their statistics. For certain countries for which data were not available, estimated figures are given and are, therefore, liable to error. In spite of all these obstacles, the department have enriched the fund of information contained by adding new tables regarding national income of eight countries (the U.S.A., the U.K., Australia, Canada, New Zealand, Union of South Africa, Argentine and Palestine). Two other new tables relate to marriage and marriage rates. The table concerning world trade in terms of Dollars has been omitted from this issue, and some other improvements have been carried out. This is a very useful addition to any statistical library.

M. C.. SATYANARAYANA.

**The Artificial Insemination of Farm Animals.** Edited by Enos J. Perry. (Chapman & Hall, Ltd., London), 1947. Pp. 265. 15*sh.*

The development and use of the technique of Artificial Insemination have in recent years eclipsed the progress of other phases of Animal Industry. The mass of scientific information that has accumulated has been brought out in an easily understandable form in this handbook. This helps the animal breeder tremendously in quickly and safely overcoming the time and cost factors in achieving increased production of the various commodities of animal origin. The need for this has probably been never so urgent as now, particularly in India.

This publication is a British edition of the original U.S.A. edition of 1945; but, instead of being brought up to date, it has all the previous printing errors. The editor having no easy job in co-ordinating a number of contributions, the handbook suffers from repetition and lack of uniformity in the presentation of the subject-matter. Inclusion of tabular statements for heat duration, sperm concentration in an ejaculate and the sperm number, and charge-volume required for successful insemination in different species, and a comprehensive discussion on the disorder in reproductive phenomena, on fertility variation and control, would have greatly helped the work of the inseminating centres.

Lucid citations of modern breeders' successes in breeding for improvement, will encourage the future cattle breeders, whetting as they do the appetite for more knowledge of the mystery and manifestations of biotic inheritance.

Chapters 10, 11 and 12 are, however, out of place and not without errors (coefficient of inbreeding, etc.). Probably in an overzealous attempt to simplify, expressions have crept in, which rather detract from the scientific accuracy of the new and quickly-grown knowledge of Genetics. Characters may be hereditary or environmental or due to a combined effect of both these factors. They may be said to be of three kinds but not due to three factors, as mentioned on page 151. Gene legends in the body of the text should be italicised. Further, it may be clarified that the $F_2$ in a tri-hybrid cross covers a total of 64 *individuals* making the full ratio, which comprises only 27 different genotypes grouped under 8 different phenotypes, *but does not have* 64 *genotypes* as is stated on page 158. The difference between sex-influenced and sex-limited characters is hardly clear. With these topics the operators of the artificial-insemination centres need not have been bothered.

The rest of the handbook will, however, be immensely helpful to the operators of the artificial insemination centres. Prof. Enos J. Perry has been a notable pioneer in the U.S.A. for the popularisation of artificial insemination, and his comprehensive discussion of the Organization Aspects is very useful. The misconceptions regarding artificial insemination are pointed out, and helpful suggestions given all through the book for making Artificial Insemination service to be widely adopted. But in India, the operator must understandingly tackle the agrarian and the village folk who are the virtual custodians of our cattle industry.

S. V. CHANDIRAMANI.

**The Age of the Saline Series in the Salt Range, Punjab.** *Proc. National Academy of Sciences, India*, Sec. B, Vol. 16, 1946.

The Age of the Saline Series of the Punjab has been the subject of a long-standing controversy. A Symposium on this subject was held in Poona during 1944 and the opinions expressed by the Palæontologists led by Prof. Birbal Sahni, based on a study of the fossils, were all in favour of a Tertiary Age, but there were sharply divided views amongst the Geologists who based their conclusions on the field evidences. The consensus of opinion then was that further detailed investigations should be made to scrutinise the field data and substantiate the fossil evidences. Accordingly, excursions were arranged to selected exposures of the rocks, and extended studies of fossil material were also made. These developments led to a second Symposium during December 1945, at Udiapur, under the joint auspices of the National Academy of Sciences and the Indian Academy of Sciences. Twenty papers have been contributed to this Symposium by different authorities both from India and abroad, and the discussions cover almost every phase of this vexed question—setting forth not only the results of the most careful and intensive micro-fossil studies but also of the field excurions.

On going through the above Proceedings, it is clear that the fossil evidence in favour of the Tertiary Age is now more convincing than ever and that the reading of the field evidence requires a revision on the part of those who uphold a Cambrian or Pre-Cambrian Age. As Prof. Sahni has warned, "Between the testimony of the rocks and the testimony of the fossils there can be no real conflict," it looks reasonable that the verdict of the fossils should be accepted and the tectonic interpretations reoriented in the light of these facts.

M. B. R.

**Mathematics as a Culture Clue and Other Essays.** Vol. I of the collected works of C. J. Keyser. (Scripta Mathematica.) Pp. 277. $3.75.

The proposition that "the type of Mathematics found in any major culture is a key to the distinctive character of the culture taken as a whole" was first put forth by Oswald Spengler in his *Der Untergang des Abendlandes*. Keyser meditates on this proposition and is inclined to support it. He devotes the major portion of his essay to the examination of classical Western culture, and infers that there is a family-likeness between classical mathematics, classical painting, classical philosophy, etc., which are all characterised by the absence of the concept of the *infinite* and are confirmed to the *finite*. But as the author himself points out, the proposition is yet to be supported by the general consensus of expert opinion. In fact it is a debatable proposition. For, as a freak of nature, a mathematical genius, far above the level of the ordinary folk, may appear in any country at any time. It is, therefore, quite possible that the advancement of mathematical work in a given country at a time is not representative of the culture. For instance, the Indian genius, S. Ramanujan, was not intelligible to his contemporaries in his own country and had to go abroad!

Besides the essay on Culture Clue, the collection contains eleven other essays on interesting topics such as "The Meaning of Mathematics", "The Bearings of Mathematics", "Mathematics and the Dance of Life", "Scientists Teach Laymen", etc. The reader may feel that some of the statements in the book are audacious or exciting, but the thinking is always clear and the presentation simple and straight. The printing and get-up are quite good.

B. S. SASTRY.

## Publications Received

"Annual Report of the All-India Institute of Hygiene and Public Health, Calcutta, 1944-45." (Published by the Government of India Press, Calcutta, 1948.)

"Portraits of Eminent Mathematicians". (Published by Chronica Botanica Co., N.Y. Portfolio I. II Edn.)

"John Couch Adams and the Discovery of Neptune". By W. M. Stewart. Occasional Notes No. 11, August 1947. (Royal Astronomical Society, London.)

"A Note on the Occurrence of Mica in Hyderabad State". By Khurshid Mirza, Director of Mines, and Geological Survey, Hyderabad (Deccan), 1943. Price As. 8.

"Bamboo for Pulp and Paper Manufacture"—Parts I-III. By M. P. Bhargava, Forest Research Institute, Dehra Dun, 1946. Price As. 9.

# SCIENCE NOTES AND NEWS

## Inter-University Board

The Inter-University Board met in Cuttack during the first week of December under the presidency of Mr. N. K. Sidhanta.

The Board passed a resolution on a proposition sent by the Bombay University expressing the opinion that it is in general agreement that the autonomy of Universities be maintained and that their academic independence be ensured. This principle is urged to be borne in mind when any new legislation affecting universities is contemplated.

The question of the national language of India came up before the Board on two propositions, one from the Standing Committee which passed a resolution in March last, but was deferred.

On the proposal of the Nagpur University for the adoption of Hindi as the medium of official minutes and correspondence, the Board considered that the suggestion was not practicable.

## University Grants Committee

In view of the recent constitutional changes and the additional responsibility that the Central University Grants Committee will have to undertake in the co-ordinated development of University education in the country, the Government of India have reconstituted the University Grants Committee with an enlarged membership. The Rt.-Hon'ble Dr. M. R. Jayakar is the Chairman, and the members are Mrs. Hansa Mehta, Sir S. S. Bhatnagar, Dr. M. N. Saha, Sir Homi Modi, the Hon'ble Dr. P. Subbarayan, Dr. Zakir Husain, Mr. K. Zacharia and Dr. B. C. Roy.

The Committee will make enquiries and recommendations regarding (1) the lines on which the Universities and other institutions of higher learning should develop, (2) the additional amounts in the form of grants-in-aid from public funds required for them, and (3) the co-ordination of their activities wih a view to avoiding unnecessary overlapping.

## Indian Ecological Society

At the General Meeting of the Society, held on the 1st January 1948, at Patna, the following Office-bearers were elected :—Dr. T. S. Sabnis (*President*); Drs. L. A. Ramdas and R. Misra (*Vice-Presidents*); Dr. T. J. Job (*Joint-Secretary*); Dr. B. S. Navalkar (*Treasurer*); and Drs. B. Pal, N. K. Panniker, T. S. Sadashivan, Mrs. E. Gonzalves and Dr. T. S. Mahabale (*Members of the Executive Council*).

## Bureau for International Understanding

The creation in Britain of a Central Bureau for Educational Visits and Exchanges on behalf of the UNESCO, for promoting International understanding has been announced by the Minister of Education. It will co-operate actively with the various agencies in Britain and abroad and supplement them by undertaking the responsibility for arranging visits to Britain by teachers and students from abroad and for exchange trips to other countries from Britain.

## Sir C. V. Raman

Sir C. V. Raman has been invited to attend the International Conference of Physicists and Chemists at Bordeaux. He will proceed to Europe by the end of March to participate in the Conference. Among other subjects. 'Raman Effect' will be discussed at the Conference.

## Award of Doctorate

The D.Sc. degree of the Benares Hindu University has been awarded to Messrs. P. .G. Deo and K. Venkateshwara Rao for research work carried out on the Joshi Effect.

## Research in Minerals

It is understood that the Government of India have decided to establish a Bureau of Mines for the purpose of research in Mines and Mineral Wealth. A recurring expenditure of about Rs. 3 lakhs has been sanctioned, it is understood, by the Standing Finance Committee.

## Madras University Endowment Lectureships

The Syndicate will proceed shortly to select persons to deliver lectures under the following Endowments for the year 1948-49. Applications for Lectureships will be received by the Registrar not later than the 15th March 1947. Applicants are requested to give full particulars regarding their qualifications, etc., and the subject selected by them for the lectures. Separate application should be submitted for each lectureship. The lectures are to be delivered before January 1949.

The following are the lectureships:—(1) *The Maharaja of Travancore Curzon Lectureships* (three); (2) *The Sir Subramanya Ayyar Lectureship*; (3) *The Gokhale Lectureship*; (4) *The Sankara Parvati Lectureship*; (5) The *Sir William Meyer Lectureship*; (6) *The Principal Miller Lectureship*; (7) *The Dr. Elizabeth Matthai Lectureship*; (8) *The Rt.-Hon. V. S. Srinivasa Sastri Lectureship.*

For further particulars regarding the lectureships, please see the University Calendar, Vol. I, Part I, 1945-46 (Appendix F).

## Elliot Prizes for Scientific Research

The Elliot Prize for Scientific Research for 1948 will be awarded to the author of the best original essays giving the results of original research or investigation in Mathematics and published during the years 1944-47.

The Elliot Prize for Scientific Research for 1949 will be awarded to the author of the best original essay giving the results of original research or investigation made by the candidate in Chemistry and published during the years 1945-48..

Any native of Bengal, Bihar or Orissa or any Anglo-Indian or domiciled European, residing in Bengal, Bihar or Orissa, may compete for the prize.

The essays of competitors must be sent in so as to reach the President of the Royal Asiatic

Society of Bengal, C/o the General Secretary, 1, Park Street, Calcutta, by the end of June 1948. Author's reprints, and not manuscripts, must be submitted.

Preference will be given to researches leading to discoveries likely to develop the industrial resources of Bengal, Bihar and Orissa.

The prizes for the next four years will be allotted as follows:—1949—Chemistry; 1950—Physics; 1951—Geology and Biology (including Pathology and Physiology); 1952—Mathematics.

All essays submitted must have been published during the four calendar years immediately preceding that for which the prize is given.

## Award for Sugar Research

The third $5,000 Intermediate Sugar Research Award will be made by the National Science Fund, Washington, U.S.A., on or about March 15, 1948. Established by the Sugar Research Foundation to stimulate scientific studies of sugar as a food and an industrial raw material which may lead to its greater usefulness; awards of $5,000 will be given in 1948 and 1949, with a Grand Prize of $25,000 to be given in 1950 for the most significant discovery of the preceding five years. Further details of terms and conditions governing the award may be obtained from the Secretary, National Science Fund, 2101, Constitution Avenue, Washington 25, D.C.

## Mathematical Instruments Office

Two committees, one for reorganising the work of the Alipore Test House, Calcutta, and the other for expanding the scope and activities of the Mathematical Instruments Office, Calcutta, have been appointed by the Government of India in the Ministry of Industry and Supply.

The Government of India have appointed a Committee under the Chairmanship of Dr. B. C. Roy to examine the existing Organisation and the possibilities of expansion of the Government Test House, Alipore. Dr. Sir K. S. Krishnan, Dr. B. C. Guha and Mr. K. N. Sharma have been invited to serve on the Committee.

The Government of India have also appointed a Committee under the Chairmanship of Dr. G. R. Paranjpe to review the organisation of the Mathematical Instruments Office, Calcutta. The terms of reference include (i) the formulation of concrete plans, both short-term and long-term, for the development of the manufacture of scientific instruments and photographic, electronic and electro-acoustic equipment; (ii) an examination of the possibility of using the Mathematical Instruments Office as a training centre for instrument-makers, mechanics, etc.; and (iii) a review of the terms and conditions of service of the employees there.

## Quality Control

A Conference on Quality Control commenced its seven-day session in Calcutta on February 8.

Dr. W. A. Shewhart, American Expert on Quality Control, presided over the Conference. Dr. L. C. Verman, Director, Indian Standards Institution, in explaining the object of the Conference said that the Indian Statistical Institute and Indian Standards Institution, joint-organisers of this Conference, had come together to take the first step in initiating the introduction of statistical methods into India's industry on the lines which have been tried and proved a success in other parts of the world. Prof. P. C. Mahalanobis, Director of Statistical Institute, also addressed the Conference.

The object of industry and applied science in India, Dr. Shewhart said, should be to satisfy the wants of 400 million people. But one could not even find out what these wants were without the help of statistics, nor could one take the final step on research concerning the design, specifications, and techniques on each of these fundamental aspects of production.

The accommodation problem of four million refugees, for instance, involved new houses which could not be constructed without building material. The improvement of quality and the maintenance of proper standards were essential in making these different branches of production fit into one complete whole. There were many research organizations, plants and industries in India but what was lacking was co-operation between various groups. India could not develop, Dr. Shewhart continued, her vast resources unless science laboratories and industrial concerns worked together as a co-ordinated whole. Quality control would enable them to do this.

A technicolour film on quality control, made by Mr. Johns Hyphen Manville of U.S.A. for training their own workers and sent on loan by the firm to India through Dr. Shewhart, was shown at the Conference.

Nearly 200 representatives from various industries and research organisations all over India attended the Conference which is expected to continue its session for nearly a week.

## Indian Standards Institution

The Engineering Division Council of the Indian Standards Institution, met on November 17 and 18 and elected Mr. S. L. Kirloskar as the Chairman.

The Standardization programme to be executed by this Council covers, among others, metallurgical, mechanical, electrical, structural, communications, aeronautical, ship-building and other industries. Among the subjects which will come under the purview of the Sectional Commtitees, to be set up under the Council, are the following: basic ferrous and non-ferrous metals, cement, timber products, lubricants, electrical plant and machinery, electrical conductors, insulators and accessories, gas cylinders, refractories, radio equipment, etc.

It was decided at the meeting that this Council, pending the formation of a Chemical Division Council, will deal with the standardization work of paints, varnishes and bituminous and tar products.

Nearly 200 technical subjects were proposed by various sources for standardization.

## Power Engineering Laboratory

Sir Vithal Chandavarker, Chairman of the Governing Council of the Indian Institute of Science, Bangalore, laid the foundation-stone of the High Voltage Engineering Laboratory of

the Power Engineering Department on the 14th February. Prof. M. S. Thacker, Head of the Department of Power Engineering, requesting Sir Vithal to lay the foundation-stone, said that this Laboratory was one in the chain of many national laboratories to be set up in due course. The Laboratory when completed would serve the research needs in power and would be of primary importance in the development of electrical supply. The laboratory would cost Rs. 23 lakhs.

## Greenwich to Hurstmonceaux

The Royal Observatory at Greenwich is being moved to its new home at Hurstmonseaux in Sussex.

After the complete transfer the Observatory to Hurstmonceaux, the ancient buldings at Greenwich will stand as a national monument and as a museum to display all the historic instruments, including those of Halley and Bradley, Pond's transit circle, Bradley's zenith sector and the old quadrants. Most famous perhaps of them all is the Airy Transit Circle, on which, with its continuous use since 1851, no fewer than 650,000 observations have been made.

Greenwich will become an object of pilgrimage not only for astronomers, but also for countless visitors from all parts of the world.

## Coffee Pulp for Cattle Feed

From the waste pulp of the coffee bean comes a new concentrate for cattle for milk production. This has been developed by technicians in U.S.A. and El Salvador. Pound for pound, dried coffee pulp has been found an effective substitute for corn concentrates in the feed of milch cattle. Coffee pulp is the fleshy covering of the bean, and is at present largely a waste product. The palatability of the pulp is increased by mixing it with banana leaves, molasses of other feed stuff.

The popularisation of dried coffee pulp in India will be of great benefit as it creates a new source of income for the coffee grower, larger supply of concentrate to cattle owners and finally, increased milk production in the country.

## Indian Wattle Bark

The Indian *Babool* bark and *Avaram* bark are not rich sources of tannins, yielding only 14 per cent. tannin as compared to 64-65 per cent. of the imported bark.

It has been established by the Madras Forest Department that Nilgiris tan bark black wattle, *Accacia mollissime* wild Syn., *Accacia decurrens* wild *var. meths. Lin.*, are identical with Natal black wattle. The bark of the trees grown in the Palani Hills and the Nilgiris has a tannin content varying from 20 to 57 per cent. The species in the Madras Province requires an elevation of 5,000-7,000 ft. and a well distributed rainfall of 60" or more for best development. The Madras Government intends to cultivate these in Palani Hills, South Coimbatore Division, in Kollegal and North Coimbatore Hills. A Research Station is also to be started at Kodaikanal to deal with plantation, production, and marketting problems.

## The Smokeless "Herl" Chula

This is a simple smokeless and fuel-saving cooking range called "Herl" Chula, as it has been developed in the Hyderabad Engineering Research Laboratories, under the direction of Dr. S. P. Raju.

This structure is built of brick and mud or only mud, and plastered with fine earth, and consists of an "L"-shaped duct with three holes for the cooking pots and an opening for the firewood. At the end of the duct is an arrangement for a big pot of water so that the hot gases before going out are utilized further to heat the water pot, thus providing hot water for the family as a by-product. The gases are finally taken out of the range by means of a clay pipe, tile or mud chimney. The opening for firewood is 6 inches wide and 4 inches high, which is enough for a family of about six. For bigger families the width may be increased to 7 or 8 inches. The size of the opening is designed to be fool-proof against unnecessary shoving in of firewood.

## Geomagnetic Storms

Geomagnetic activity during the quarter October-December 1947 was very much on the decrease as compared with the earlier three quarters. Some details of the geomagnetic disturbances as recorded at the Alibag Magnetic Observatory are given in the following table in which $t_0$, $t$ represent the time (I.S.T.) of commencement of the disturbance and its intense phase respectively and T the duration of the intense phase expressed in hours. The ranges in the three different elements (D, H and V) of the earth's magnetic field have also been given. D, in minutes of arc, H and V in $\gamma$ where $1\gamma = 10^{-5}$ gauss. The maximum *k-index* recorded during the disturbances have also been given.

| Date | $t_0$ | $t$ | T | Range D | Range H | Range V | $K_m$ | Nature of commencement |
|---|---|---|---|---|---|---|---|---|
| 1947 | H. M. | h. m. | hrs. | min. | $\gamma$ | $\gamma$ | | |
| September 30 to October 3 | 23 40 | 09 00 On Oct. 1 | 8 | 8·2 | 224 | 86 | 5 | Sudden |
| November 9–10 .. | 14 26 | 16 34 | 2½ | 5·1 | 217 | 46 | 6 | Sudden |

133-48 Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore

Current Science

Vol. XVII] MARCH 1948 [No. 3



# DYNAMIC X-RAY REFLECTIONS IN CRYSTALS*

## 1. INTRODUCTION

DIAMOND, by reason of its exceptional properties, has played a notable part in the development of our notions concerning the solid state of matter. For instance, when Einstein put forward his famous theory of specific heats, it was the only known solid exhibiting a marked variation of specific heat with temperature, and one may well believe that it was the behaviour of diamond which inspired Einstein to apply quantum theory to the problem. More recent studies on diamond indeed suggest that the properties of this remarkable substance are the pathway to a correct appreciation of the theory of the solid state. That this remark is applicable to the theory of the propagation of X-rays in crystals and of the attendant phenomena forms the major theme of this address.

Diamond has interested the writer ever since 1930, and numerous investigations with it undertaken at his suggestion have appeared in the earlier volumes of the *Indian Journal of Physics* and subsequent to 1933 in the *Proceedings of the Indian Academy of Sciences*. Early in the year 1940, in connection with certain spectroscopic investigations, a few octahedral cleavage plates of diamond were acquired. These formed the beginnings of a collection that has since grown up very considerably. A powerful X-ray set-up was available at the Institute, and Dr. P. Nilakantan undertook to obtain some Laue patterns with diamond, using a copper target as a source of mono-

* Jubilee Address to the South Indian Science Association delivered by Sir C. V. Raman at Bangalore, on the 25th March 1948.

chromatic X-radiation. The photographs revealed a phenomenon of such a remarkable character and so clearly incapable of explanation on the basis of familiar X-ray theory that the writer had no hesitation in announcing in *Current Science* of April 1940 the discovery of a new X-ray effect, introducing it in the following words: "The new X-ray phenomenon described and illustrated in the present communication has in its physical nature, something in common with both the Laue and the Compton effects: it is a specular reflection of X-rays by thereby confirming the quantum-mechanical nature of the effect. Using fine slits with correspondingly long exposures, the reflections were found to be extremely sharp, thus precluding any explanation of them as due to the thermal X-ray scattering. The appearance of the reflections at various settings of the crystal was explained in the *Current Science* article on the basis of certain considerations regarding the phases of the excited vibrations. These considerations and the formula for the geometric law of the quantum reflection derived

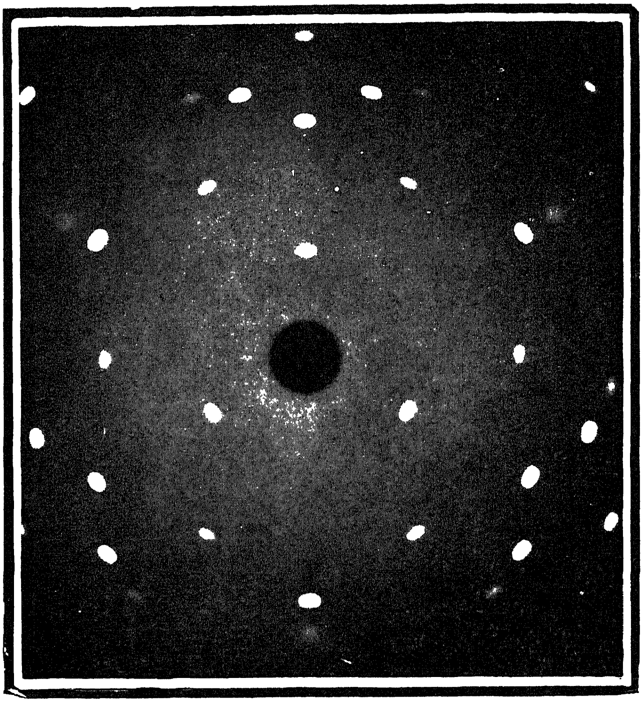


FIG. 1. Dynamic X-Ray Reflections by Diamond. CuK$_\alpha$ Radiation (After Raman and Nilakantan, April 1940)

crystals but with a change of frequency explicable only on quantum-mechanical principles." The article went on to suggest that the observed reflections had their origin in the excitation of the eigenvibrations of the diamond structure by the incident X-radiations. It was also pointed out that in view of the known high frequency of these eigenvibrations, the thermal agitation in the crystal could not be the operative cause of the reflections. Subsequent investigations showed that their intensity was not notably influenced by heating the crystal or cooling it down to liquid-air temperature, therefrom were confirmed with all desirable precision by exact measurements.

The new ideas and principles emerging from the case of diamond naturally suggested a series of investigations with other crystals. The results were published in a series of seven papers in the *Proceedings of the Indian Academy of Sciences* between May and November 1940, and finally in a symposium of fifteen papers under the general title of the "Quantum Theory of X-Ray Reflection" as the October 1941 issue of the *Proceedings*. The subject was then laid aside. It appears opportune now to

return to it, and that some years have elapsed in the interval has not been altogether a disadvantage. For, the studies on several allied topics made at Bangalore during these seven years have cleared the ground for a proper understanding of crystal physics generally and of X-ray physics in particular. Most of the criticisms of the Bangalore publications which were put forward at the time by different writers are seen in the light of the later developments to be without substance or justification.

faces, the phase of the motion being opposite in every pair of adjacent cells of the pattern. The configuration of the nodal pattern would be determined by several factors, *vz.*, the size of the crystal, its form and the external boundary conditions, the elastic constants and their variation with direction, and it would also be different for each different mode with its particular frequency. It would not be easy—even if it were theoretically possible—to determine the pattern even for a single

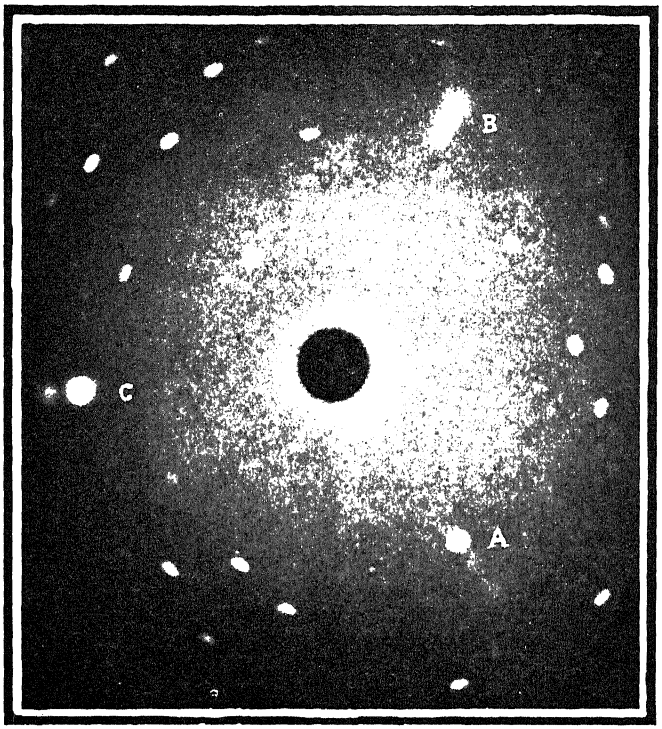



FIG. 2. Dynamic X-Ray Reflections by Diamond. CuK$\alpha$ and K$\beta$ Radiations
(After Raman and Nilakantan, April 1940)

## 2. The Thermal Scattering of X-Rays

In considering the phenomena attending the passage of X-rays through a crystal and resulting from the movements of the atoms in it (due to the thermal agitation or other cause), it is desirable in the first instance to fix our attention on such of these movements as can be identified with the elastic vibrations of the solid. There would be an immense number of such movements or normal vibrations possible. Each of these modes extends through the entire volume of the crystal and has a distinctive frequency and a characteristic pattern of nodal surfaces,

one of the modes, much less for all of the immense number whch need to be considered. We notice, however, that all the factors which are determinative of the nodal pattern are of a *macroscopic* character. Hence, we are justified in inferring that in no case would the nodal pattern bear any particular or specifiable relation to the atomic architecture of the crystal, under which term we refer to the position of the atomic layers and of the individual atoms. The situation here depicted is seen to have important consequences when we proceed to consider the optical aspects of the problem. Fixing our

attention on a particular mode of elastic vibration of frequency $\nu^*$, we note that each atom in the track of the X-ray beam can be regarded as a source of secondary radiations of frequency $\nu$, $\nu+\nu^*$, and $\nu-\nu^*$, $\nu$ being the frequency of the incident X-radiation. The strength of the radiations of frequencies $(\nu \pm \nu^*)$ would be determined by the amplitude of oscillation of the atoms, while the phases of the scattered radiations as received at any point would be determined by the optical paths and *by the phase of the oscillation of the atom.* Since the latter phase is reversed whenever we pass from one side to the other of each nodal surface in the elastic vibration, it follows that the phases of the scattered radiations would be reversed at the same time. Hence, in the final summation over all the atoms in the track of the X-ray beam, the radiations from the atoms included in the successive cells of the nodal pattern would tend to cancel out by interference. Any resultant left over would arise from the varying amplitudes of the vibrations of the atoms and the varying density of their distribution; but since these variations are uncorrelated, the net result would be unpredictable for any particular $\nu^*$ and would also be different for each different $\nu^*$.

We thus arrive at the conclusion that the scattered radiations from the atoms arising from the elastic vibrations in the solid cannot possibly conspire to build up anything in the nature of a diffraction pattern having a recognizable relationship to the atomic structure of the crystal. That a contrary conclusion has been reached by various writers is evidently due to the erroneous nature of the premises on which they have proceeded to consider the problem. We may remark in this connection that in the case of a finite crystal, it is not permissible to postulate the propagation of plane elastic waves in various directions and to consider the optical results of each such wave *independently.* The proper analysis of the elastic vibration is into a set of normal vibrations, each with its own pattern of nodal surfaces determined by the form of the crystal and other factors as stated above.

### 3. The Origin of the Extra Spots

The foregoing remarks make it evident that it is not possible to explain the so-called "diffuse" spots in the Laue patterns of crystals other than diamond on the basis of the elastic vibrations excited in them by thermal agitation or otherwise. This is obvious in the case of diamond by virtue of the observed sharpness or specu-

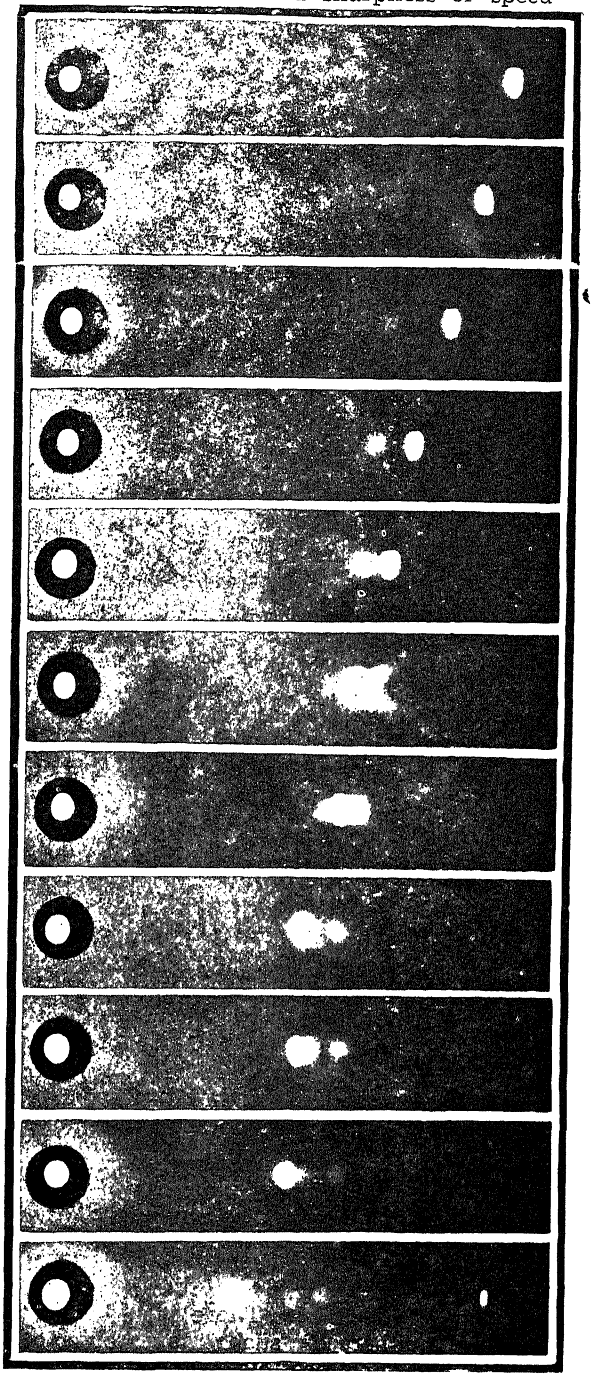


FIG. 3. Sequence of Changes in (111) Reflections by Diamond with Alteration of Crystal Setting (After Raman and Nilakantan, November 1940)

lar character of its extra reflections, but it is equally true for all crystals. In other words, the phenomena exhibited by diamond are exceptional only in the sense that all the properties of diamond are exceptional, *viz.*, they stand out so clearly as to leave little room for being misunderstood. The criticisms of the Bangalore work put forward by various writers who have sought to brush aside the facts observed with diamond on the basis of *ad hoc* explanations or by writing them down as "secondary" phenomena, are thus clearly misconceived.

In the Laue pattern of an octahedral cleavage plate of diamond obtained when the X-ray beam is parallel to a trigonal axis, the extra spots appear symmetrically placed about that axis, and are readily recognized as specular reflections by the (111) spacings of the incident monochromatic radiation, analogous to the ordinary or static X-ray reflections, but obeying a different geometrical law. It follows that the atomic movements in the crystal which give rise to them are related to the structure of the crystal in a precisely definable manner, instead of being entirely uncorrelated with them as in the case of the elastic vibrations. As we have seen, the incapacity of the elastic modes of vibration to give rise to such effects arises from the fact that they are determined by *macroscopic* factors, including especially the existence of an external boundary and the conditions there subsisting. Even in the purely conceptual case of an infinite crystal where the elastic disturbances can be considered as waves, different wave-lengths and directions of propagation can co-exist, thereby precluding the possibility of giving rise to sharply defined "extra" spots. For the same reason, therefore, the atomic movements in diamond which give the observed reflections cannot be described as waves whose wave-lengths and directions are arbitrary in the same manner as those of elastic waves in an infinite solid. Indeed, the analysis of the positions of the reflections by the (111) planes of diamond as actually observed for various settings shows that the planes of constant phase in the atomic movements are severely restricted in their orientation, being in fact exactly parallel to the (100) planes in the crystal. Which of the three sets of these planes is effective, or whether all of them come into operation depends on the particular setting of the crystal with respect to the incident X-ray beam.

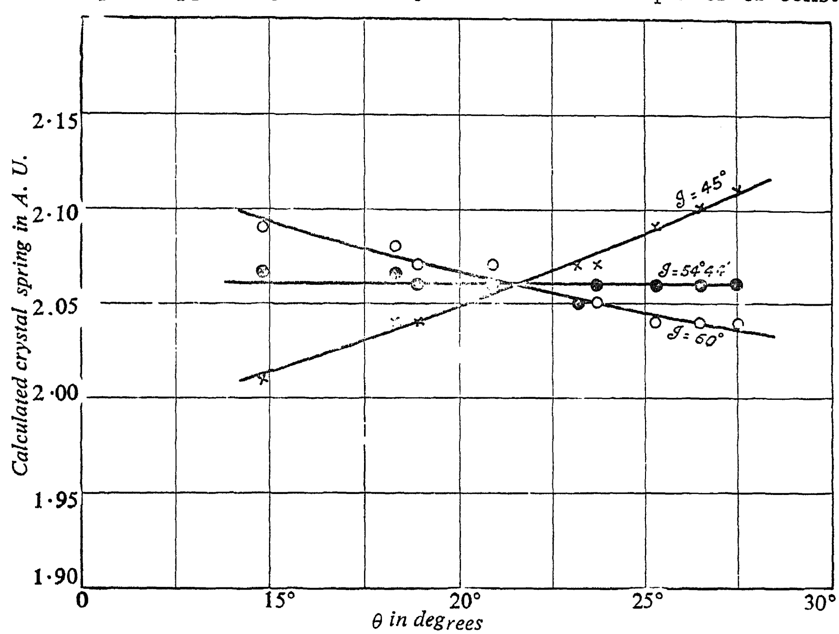



FIG. 4. Coincidence of Phase Waves in Diamond with Cubic Planes
(After Raman and Nilakantan, November 1940)

Thus, alike from theoretical considerations and from the experimental facts, and as in the case of diamond, so also for all other crystals, it is clear that the origin of the "extra" spots has to be sought in types of atomic movement which are precisely related to the structure of the crystal, and which unlike the familiar waves of elastic theory,

are uninfluenced by the presence of an external boundary, and whose planes of constant phase are restricted to certain specified orientations. By a simple process of exclusion, we are forced to the conclusion that these movements are the eigenvibrations of the crystal structure which manifest themselves in spectroscopic studies with crystals, and further, that such eigenvibrations possess characters wholly different from the vibrations pictured in the classical theory of elasticity.

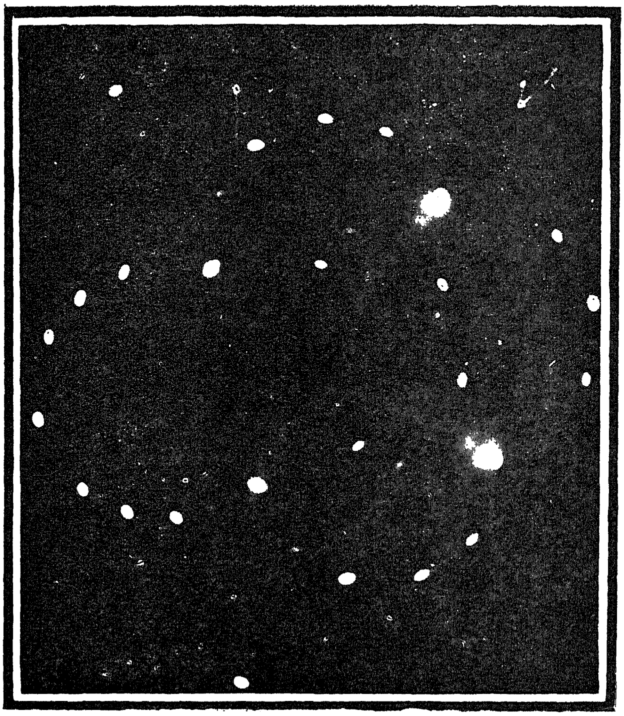


FIG. 5. Dynamic Reflections by Sodium Nitrate at 225° C. (After Raman and Nilakantan, May 1940)

### 4. The Eigenvibrations of Crystal Structure

Our argument thus leads us to recognize the fundamental relationship between the physics of X-ray propagation in crystals and the physics of their spectroscopic behaviour. It also shows that the older views which sought to force the spectroscopic picture of crystal behaviour into a pattern similar to that of its elastic vibrations are fundamentally erroneous. Indeed, the X-ray phenomena observed with diamond compel us to make a fresh approach to the theory and of their relationship to the spectroscopic phenomena. Such an approach has been made in the introductory paper of a symposium on "The Dynamics of Crystal Lattices", published by the *Indian Academy of Sciences* as its *Proceedings* for November 1943. More recently, the spectroscopic consequences of the new theory have been worked out and the results compared with the experimental facts in numerous cases, *viz.*, diamond, magnesium oxide, the alkali halides, etc. The results have been published as a symposium of the eigenvibrations of crystal structures of nineteen papers on "The Vibration Spectra of Crystals" forming the *Proceedings of the Indian Academy of Sciences* for December 1947. The theory is so successful in explaining the facts of observation, including such as are wholly unintelligible on the basis of the older theories, as to leave no room for doubt regarding the essential correctness of the new approach.

The main result of the new theory is that, whereas on the older theories the vibrations both in the acoustic and optical ranges of frequency yield continuous spectra, they

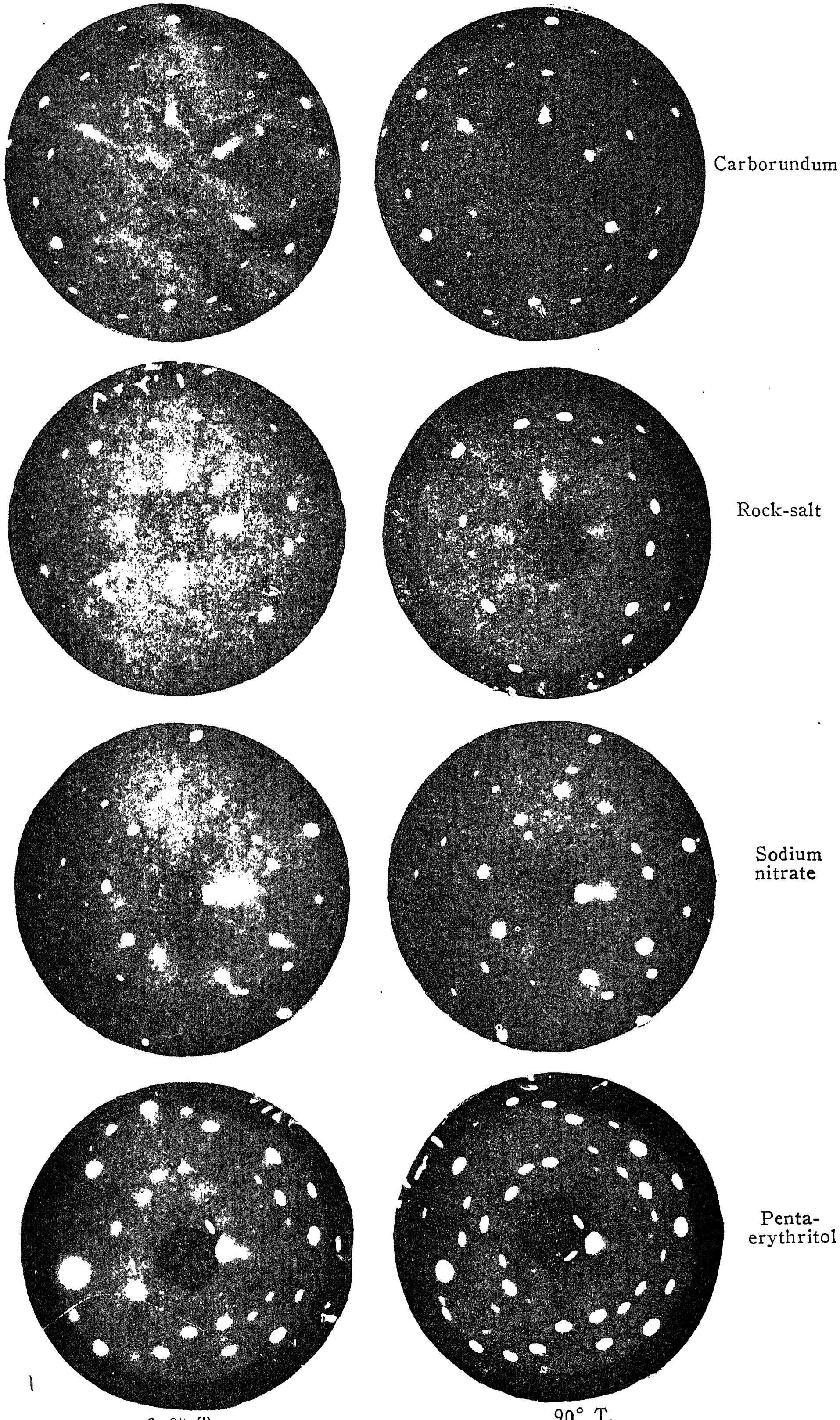



FIG. 6. Quantum X-Ray Reflections by Crystals at 30°C. (*Left*) and —180°C. (*Right*)
(After C. S. Venkateswaran, September 1941)

appear in the new theory as a set of modes with sharply-defined monochromatic frequencies, $(24p-3)$ in number, there being $p$ atoms in the unit cell of the crystal lattice. In $(3p-3)$ of these modes, the vibrations has the same amplitude and phase in adjacent cells of the lattice, while in the remaining $21p$ modes, the amplitude is the same while the phase alternates in successive cells along one, two or all three of the axes of the lattice. The actual number of discrete frequencies would be much less than $(24p-3)$, if the crystal belongs to the higher symmetry classes. In the case of diamond, for instance, the $(3p-3)$ frequencies reduce to only one, where the $21p$ frequency reduce to seven in number. The vibrations and their respective frequencies may be regarded as characteristic properties of the dynamic unit of the crystal structure which is a super-cell with twice the dimensions and eight times the volume of the unit cell of the lattice. It may be remarked that the 3 excluded degrees of freedom form the residue which goes over into the spectrum of the elastic vibrations of the crystal.

which the evidence of excitation is furnished by spectroscopic study, *e.g.*, observations of the spectrum of the scattered light, of the absorption in the infra-red, and also in favourable cases of the absorption in the

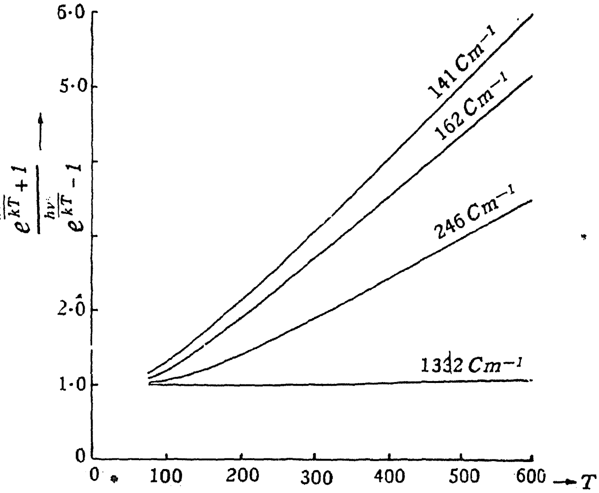



FIG. 7. Temperature Factor of Quantum Reflection, Theoretical (After Raman, September 1941)

visible spectrum, and of the luminescence spectrum at low temperatures. The mono-

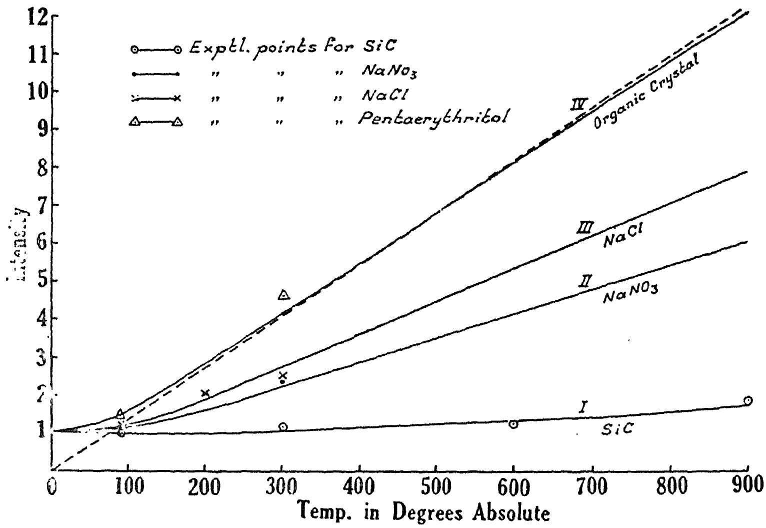



FIG. 8. Temperature Factor of Quantum Reflection, Experimental (After C. S. Venkateswaran, September 1941)

## 5. Excitation of the Eigenvibrations

It is possible to excite the eigenvibrations of a crystal in various ways, the most obvious and universal method being that of thermal agitation which is always effective, provided the temperature is sufficiently high. We have also various optical methods in

chromatic character of the vibration frequencies comes directly into evidence in all such cases, irrespective of the particular method of excitation adopted, showing thereby that it is a characteristic property of crystal structure and not a consequence of the particular method of excitation employed. The activity of the individual modes

may, however, differ in respect of the different methods of excitation. For instance, in the cases of light-scattering and of infrared absorption, they are complementary and mutually exclusive in respect of the fundamental frequencies in the case of with appreciable intensities in the optical methods of excitation indicates that the vibrations excited are highly localised, and that in consequence, the vibration amplitudes are comparable with the interatomic distances. If, on the other hand, the excitation

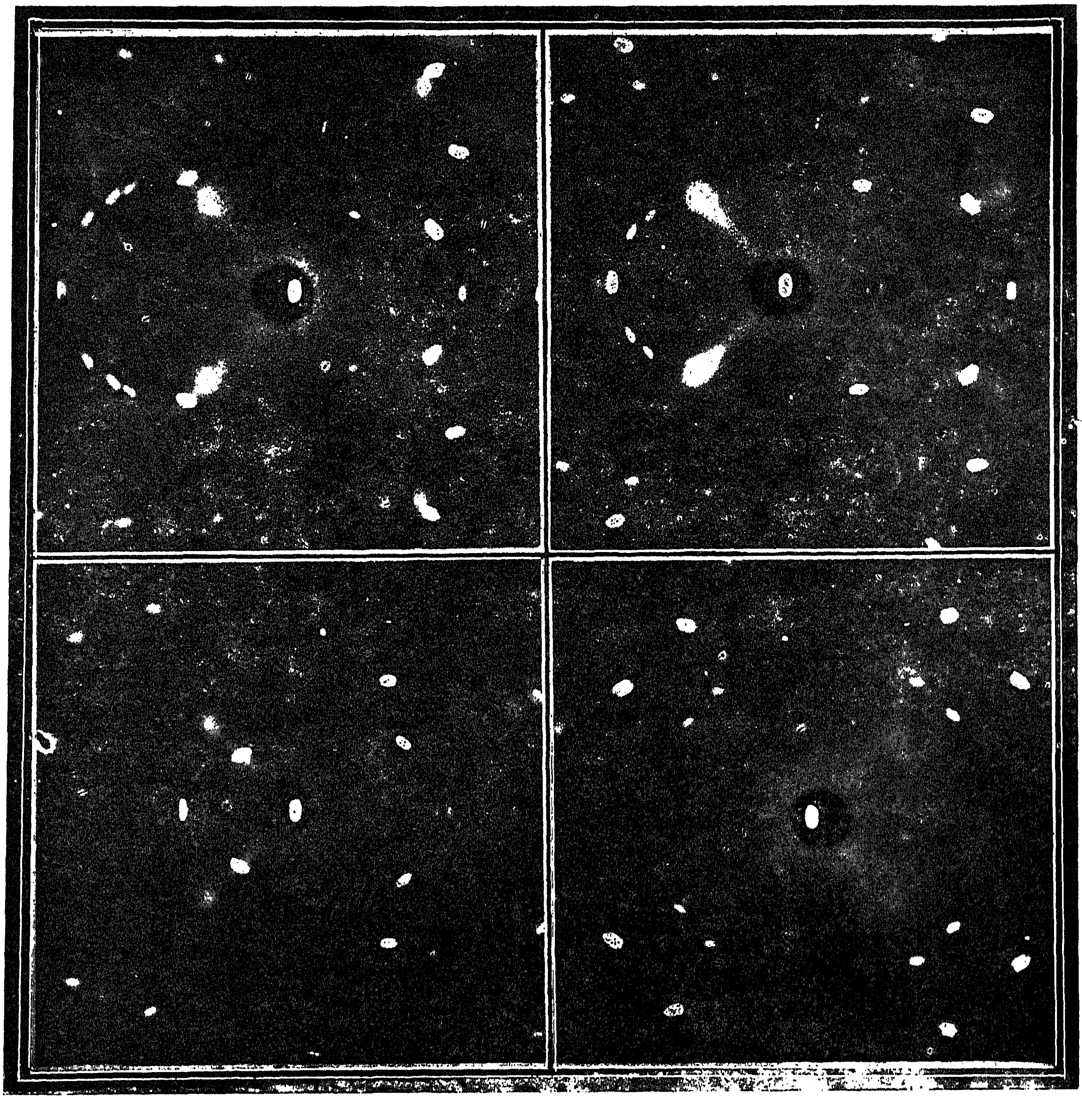


FIG. 9. Dynamic X-Ray Reflections by Hexamethyl Tetramine
(After C. S. Venkateswaran, October 1941)

crystals possessing a centre of symmetry. This feature disappears when we consider the overtones and summations of the fundamental frequencies where anharmonicity, mechanical or optical, comes into play. The appearance of overtones and summations extends over a large volume in the crystal, the energy of a quantum of the particular frequency distributed over such volume would result in the amplitudes being infinitesimal and hence incapable of giving rise to overtones or summations with appre-

ciable intensities. On the other hand, in the excitation which results in dynamic X-ray reflections, we must picture the vibration as occurring in the same phase or with slowly varying phases over an extended volume of the crystal, since otherwise no observable reflection could result. The larger the volume in which the excitation occurs, the more sharply defined would the resulting reflections be. The extreme sharpness of the dynamic reflections in the case of diamond where the bonding between each lattice cell and the next is strong is readily understood on this basis, while the diffuseness of the "extra" spots in weak crystals, such as for instance organic compounds, is also intelligible as a consequence of the weakness of the binding between the successive cells of the structure. It should be remarked that the restriction in the volume of excitation would result in an increase of the amplitude of vibration, and this would exactly set off the decrease in the number of lattice cells which co-operate to give a dynamic reflection. The amplitude of vibration, would also be dependent on the masses and binding forces involved. Hence, it is quite possible for crystals which give only "diffuse" spots nevertheless to exhibit them with notable intensities.

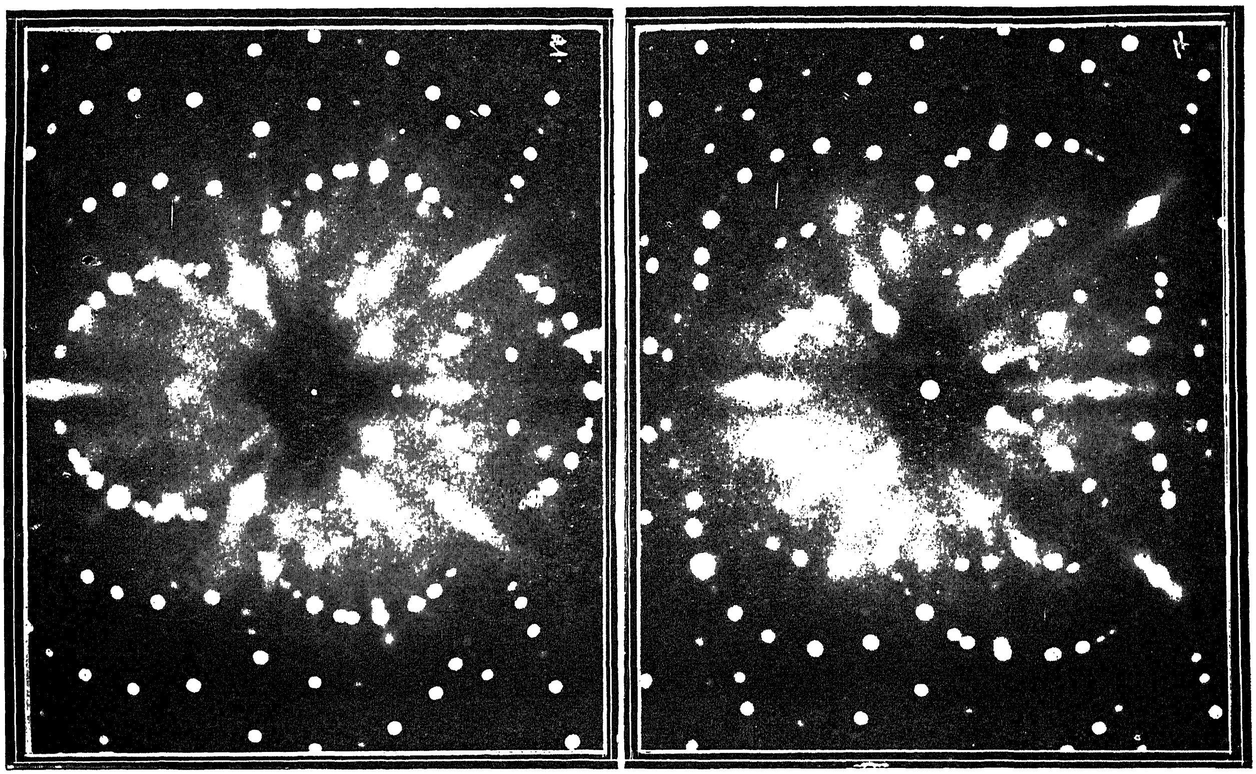


FIG. 10. Dynamic X-Ray Reflections by Calcite for Different Settings
(After Nilakantan and Nayar, October 1941)

### 6. Influence of Temperature

In many cases, and especially where the binding forces are weak or the atomic masses are large and hence the eigenfrequencies are low, the eigenvibrations would be excited by thermal agitation, and hence such thermally excited eigenvibrations would have to be considered in respect of the X-ray phenomena as well. The theoretical position is somewhat analogous to that arises in the case of the excitation by optical methods, *viz.*, the scattering of light, where we are concerned with both positive and negative shifts of frequency in the spectrum of the diffused light. Instead of the ground state, the thermally excited state of eigenvibration would be the starting point for their excitation by the

incident X-radiation, and hence it can occur in either direction, *viz.*, further excitation or a de-excitation. The dynamic reflections arising in either way would appear superposed in the finally observed result, and the net consequence to be theoretically expected would be an increase in the intensity of the reflection with rising temperature, besides subsidiary effects such as increase in diffuseness. The magnitude of the increase of intensity would depend on the frequencies of the eigenvibrations which are effective in giving the observed reflection, and the proportionate increase would be the smaller, the higher the frequency or frequencies under consideration. *Per contra*, the intensity would diminish when the temperature is lowered, but since the quantum-mechanical excitation would persist in every case, the reflection would not disappear even at the lowest temperatures but would on the other hand persist. The intensity at low temperatures would be relatively the largest in the case where the eigenvibrations involved would have relatively the highest frequencies. There is no reason to expect any notable dependance of the magnitude of the temperature variation on the setting of the crystal at which the dynamic X-ray reflections are recorded.

7. Dependence on Crystal Structure

It will be evident from what has been stated above that the pattern of dynamic X-ray reflections by a crystal would be largely determined by the number and nature of its eigenvibrations and their frequencies, and also on the manner in which these eigenvibrations influence the structure amplitudes of the various crystal planes. Each individual case would have to be considered on its merits as in the case of static X-ray reflections, but general considerations regarding the nature of the oscillations possible in ionic, molecular or layer lattices would enable us to predict or at least understand the general nature of the dynamic X-ray patterns to be expected in these respective cases. But it would take us beyond the scope of the present article to enter into these details.

C. V. Raman.

*Note.*—The cost of printing this article has been met from a generous grant from the National Institute of Sciences, India.

# EDITORIAL NOTE

## SCIENTIFIC FILMS

The influence of Science and its technological applications on the social structure of modern civilisation is becoming increasingly apparent. Science is ever in the process of modifying the relations of man to his natural environment and between social groups of human beings. It is clear that scientific research and knowledge offer man the alternatives between improving and degrading social life: they can help or obstruct solution of social problems.

In democratic countries the choice of the alternatives largely depends, not so much on the few men at the laboratory bench, but on the large majority who elect their ruling representatives. And it is a truism that the more enlightened and responsible the electorate, the greater the calibre of the administrators and higher the efficiency of administration. Therefore, the essential prerequisite for a true and successful democracy is a liberal education which includes a certain basic knowledge of science that enables the farmer and the factory hand, the trader and the consumer appreciate advances in applied and technological branches.

In free India, where there is yet enormous scope for application of available information and technological processes, science has a conspicuous role to play before she could come on a par with the Western world. We have to look to science to unfold a new era of sustained economic prosperity, to prevent or eliminate disease, to strengthen the defences of the country and guarantee a permanent peace. The broad attainment of these goals demands a well-informed public. Science must be intelligently and accurately explained to the layman so that he may understand its possible contributions and also its limitations in reference to problems of human welfare and that he may actively help and participate in its applications. Towards this end every available means should be mobilised by the state and the public in order that the level of knowledge of the producer might be raised to the highest.

While simple and lucid expositions of scientific subjects and their application to industry and agriculture are growing popular, they are not within effective reach of the unlettered man in India. He could nonetheless be approached through visual education. Even for literates this system has come to be recognised as the most telling and rapid means of enlightenment on a wide variety of subjects. In many countries, Educational Films have become a common and much-appreciated method of broadcasting the progress in science and technology. In Britain itself there are more than thirty Scientific Flm Societies, and in America almost every college and university has its Film unit.

The method of learning through films owes its ubiquitous popularity to the fact that man

always thinks in terms of pictures. It is, therefore, far easier for him to comprehend in terms of his "natural language". And it should be admitted that the alphabet is only the second best, and lacks the direct appeal that pictorial presentation offers.

Advances in cinematography promise, further, a potent tool in the understanding of natural phenomena, like plant growth, fertilisation, bird flight, animal movements and certain metabolic process of plants and animals. High speed and micro-motion techniques, through expansion or abridgement of the time factor, have opened up new fields of investigation in fundamental and applied aspects of science. It is thus possible to analyse and get a better insight into the process of germination, flowering, the spread of the flame and the combustion of gases in internal-combustion engines, and stresses in jet turbines blades and other phenomena which cannot be otherwise understood. In industry, time and motion study of factory hands and of technical processes have invariably led to improvements resulting in reduced fatigue to the worker, increased efficiency and larger production.

The utility of films, in education, indeed, holds endless possibilities. In our country, where adult education can contribute so much to agricultural and industrial production, films on mechanised agriculture, soil fertility, plant nutrition, role of trace elements in crop production, application and utility of artificial manures and compost, village sanitation and personal hygiene, and presentation to the factory worker the industry in full perspective and his place in the production of the final commodity will go a long way in reducing the acute shortage of food and manufactured goods in the country.

The formation of the Scientific Film Society in Bangalore is a step in the right direction for achieving the above-mentioned objectives. The Society has, among its aims and objects, the promotion of interest in scientific films and investigation of the means of application of these for the benefit of human welfare in India, rendering technical assistance to scientists to produce their own films relating to their own researches and to maintain a film library for the use of scientists and the public. The availability of a reasonably cheap film projector and a continuous stream of scientific films within easy reach should make "Home movies" almost as popular as the gramophone and the radio.

That need and scope for such a Society is fully appreciated by our statesmen is seen by the hearty support offered by the Prime Minister of Mysore when he inaugurated the Society. The Ministers both at the Centre and in the Provinces have frequently made it clear that they are alive to the possibilities of the medium of visual (and auditory) education. It should be possible for the Ministry of Education at the Centre to begin with a new section for the production and propaganda of scientific and education films under the guidance of experts. In the meanwhile it is open to the scientists and the public to establish active branches of the Scientific Film Society in every City and help further the cause of Science and Industry in India. And we are confident that this movement will receive the munificent support of the various governments in the country and the co-operation of similar organisations abroad.

---

## CONTACT RECTIFIER FOR LOW-VOLTAGE HEAVY CURRENTS

At a time when further development of electrical conversion machinery was considered to have come almost to a standstill, the development of a contact rectifier by Siemens Schuckert, after years of research and operating experience, has focussed the attention of engineers on this new equipment. The American Institute of Electrical Engineers in their summer meeting last year, considered it worth while to discuss this new equipment and examine the possibility of its being used in Electrochemical industries in place of the now well established Mercury Arc Rectifier, especially for low voltage heavy current work.

The new equipment consists of a contact mechanism synchronously driven and adjusted to make metallic contact between the A.C. source and the D.C. load at proper time intervals, *i.e.*, when the particular phase of the A.C. system is capable of delivering energy in the desired direction. These contacts are actuated by a shaft carrying different eccentrics. A feature of this rectifier is the use of saturable reactors with what is termed as "elastic excitation" to obtain good commutation and regulation.

The contact rectifier is a very interesting development, and the advantages claimed make it particularly suitable for use in electrochemical industry. Overall efficiencies of 97 to 98 per cent., including transformers, have been reported for low voltage operation. Small space requirements, low maintenance costs, absence of auxiliary equipment are some of the distinct advantages mentioned. Reliability of operation is claimed from the operating experience at Hannover. It is stated that during three years of continuous operation the short circuit safety device acted only twice. The contact life was about two months per set of contacts.

From the data available at present, it can be stated that the contact rectifier, with slight improvements in design and further operating experience, might soon make a strong claim for itself in the field of low voltage heavy current operation.

Further information about this rectifier can be gleaned from the following references:

(1) *British Intelligence Objectives Sub-Committee Report*, No. 408. (H.M. Stationary Office, London.)
(2) Otto Jenson: *A Mechanical Rectifier Trans. of the Electrochemical Society*, **1946.**

# FIFTEEN YEARS OF SULPHA DRUGS—A PERSPECTIVE

K. GANAPATHI
(*Department of Chemotherapy, Haffkine Institute, Parel, Bombay*)

## INTRODUCTION

IT was in 1932 that the method of preparation of prontosil was patented and the therapeutic property also discovered, though this discovery, which "created a sensation and shook the world", was announced by Domagk only in 1935. Since then, a tremendous amount of work has been published with the accumulation of a great deal of knowledge. The lapse of fifteen years has tempered the initial enthusiasm about the efficacy of the drugs, and the new ideas and data have been subjected to critical examination, so that the time is now mature to reckon the advances made in this field. A number of critical reviews have been published dealing with the details of many aspects of the problem. As complementary to these, herein is attempted, without focussing on the details or scanning isolated sections, a perspective of the whole field.

## A NEW ERA IN CHEMOTHERAPY

It is not a mere platitude to reiterate that the discovery of prontosil and the sulpha drugs is an event of epochal importance in the history of chemotherapy. A great discovery distinguishes itself from others not merely by presenting results of immediate importance but by stimulating thought and action in many related fields thus acting as a lever to make great fundamental advances. The discovery and the progress in this field have satisfied these requirements. Ehrlich, as the father of chemotherapy, gets the credit for having recognised and enunciated the quintessence of the problem. In his time, and even subsequently, chemotherapy could not advance in practice beyond a hit-or-miss project. That the subject has been taken up seriously, in spite of this, is an eloquent testimony to its great practical importance and attractiveness even as a commercial venture akin to the extraction of gold from the rocks. There have been very useful discoveries in this field as a result of prodigious effort (such as germanin, plasmoquin, atebrin), but these have not resulted in any great fundamental advances in the field of chemotherapy. For many important questions relating to these drugs, the answers could be no better than guesses, speculations or new obscure phrases. The advent of the sulpha drugs has revolutionised the position. The physiological and bacteriological phenomena relating to chemotherapeutic action have come to be tackled on a chemical, physico-chemical and cytological level, and chemotherapy has, consequently, become the fertile intermixing ground for the physical and biological sciences. This has introduced a new outlook and logic in the subject, and has earned for chemotherapy the status of a science with a rational basis and a rational approach.

## EVOLUTION OF SULPHA DRUGS

The discovery by the French school that the therapeutic property of prontosil is due to sulphanilamide derived by reduction, simplified the problem and presented it in a clear-cut manner as regards the synthetic side. It did not take long to realise that the free amino-group in sulphanilamide is inextricably connected with the therapeutic activity and that the heterocyclic substituent at the sulphonamide radical actuates the intensity and spread of the spectrum of antibacterial activity, this concept being roughly analogous to the functions of the prosthetic groups and proteins of the enzyme systems. There was, consequently, a lively hunt in laboratories all over the world for all heterocyclic ring systems. The period, 1939 to 1942, was the most fruitful on the synthetic side, when almost all important possibilities were explored and the sequence of sulphapyridine, sulphathiazole, sulphadiazine, sulphamerazine, sulphapyrazine established. The period following which, frankly, is one of disintegration and decay, attracted the second batch of workers from many academic laboratories. Much of this work remains uncorrelated divorced from the biological testing and is, therefore, of little interest either from the chemotherapeutic or the chemical point of view.

Of the thousands of compounds synthesised and passed through the mill, only about a dozen came out as worth considering from the clinical point of view. Caustic comments have been made on this ratio, that the search for drugs in chemotherapy is a costly gamble for luck in the dark. There is justification for this. Because the discoverer of a drug gets a halo in the press and the public and even improves his financial position, the effort spent on the study of the more important fundamental problems connected with the chemotherapeutic action is not as much as that directed towards the discovery of new drugs by blind venture. However, in the present case, there is the consolation that we have gained some important knowledge. As a rough approximation, we can now scent how the chemotherapeutic activity runs through the structural section. As was not appreciated before, this activity transcends the purely organic linkage or radical level, and is governed by molecular geometry and configuration as reflected in the physicochemical properties. As a result of theoretical reasoning, it is concluded that as far as the intrinsic chemotherapeutic activity is concerned, the maximum appears to have been touched in the region, sulphathiazole, sulphadiazine and sulphamerazine. That nothing has been discovered to contradict this conclusion adds a great deal of prestige to this theoretical reasoning. From this point of view, the chemical work is now well nigh complete and the chances of discovering sulpha drugs with greater intrinsic activity than the above seem to be very remote.

When it comes to the question of using the drug clinically, the way the host deals with and affects the pathways of the drug in the physiological system assumes as much importance as

its intrinsic activity. The sulpha drugs are used for the treatment of a variety of infections wherein its action is required in such diverse sites as the blood stream, tissues, intestines, cerebrospinal fluid, urinary tract, surface of wounds, etc., depending upon the nature of the infection. The drug should reach these sites in sufficient concentrations and also be maintained therein sufficiently long. The properties of the drug responsible for the therapeutic activity will be different from those governing its transport and metabolisation in the physiological system. In addition, the acetylation of the drug and its rapid excretion from the system limit the activity and overall clinical result of the sulpha drugs. If these could be controlled, the intrinsic activity of the drug could be capitalised from the clinical point of view.

## Animal Experiments

Two properties of the drug that are of importance from the clinical point of view are: the intrinsic level of chemotherapeutic activity and the degree of toxicity, *i.e.*, the effect of the drug on the parasite and the host respectively. While the first decides the degree of response we can expect from the patient to the drug, the latter governs the degree of safety in administering the drug. Methods of measuring these two properties have now been standardised and rationalised.

Testing the effect of the drugs in experimental streptococcal, pneumococcal, *P. pestis* and other infections in mice (which are convenient to handle and require only small quantities of the drug for the screening experiments) yields clear-cut results. Though the course of the disease in these experimental infections and in human cases (except in the case of *P. pestis*) do not even closely correspond, the results obtained are quite comparable. The results of the animal experiments signify that the drug retains its antibacterial activity within the system of the host (acting as a true chemotherapeutical) and, if given a chance to meet the bacteria, can successfully destroy them. If the testing is done on a strict quantitative basis, the results can be of clinical importance. in the case of the systemic infections. It is the concentration of the drug maintained in the blood and tissues that decides the degree of therapeutic activity; the oral dose as such cannot be used for this comparison, because the blood concentration is a function of the rate of absorption, excretion and metabolisation which vary from drug to drug. For accurate estimation of the intrinsic chemotherapeutic activity and also the level of this concentration at which this effect is maximum in experimental infections, the drug-diet method, which ensures definite uniform concentration of the drug in the blood of the experimental animal, is resorted to.

In his anxiety to keep an eye on the therapeutic activity and toxicity of the drugs simultaneously, Ehrlich developed the chemotherapeutic index, and this ratio he took into consideration to grade the compounds in the order of merit for clinical use. Though in this he shifted the locus of emphasis by giving undue consideration to the maximum tolerated dose, the results were not wide off the mark as far as the arsenicals were concerned. But in the case of the sulpha drugs, the disparity will be very glaring. So long as a drug is absolutely safe in therapeutic doses, the ceiling of toxicity is not at all of importance from the practical point of view. If *a la* Ehrlich we couple chemotherapeutic activity with the maximum tolerated dose to obtain the chemotherapeutic index and use this to grade the compounds with regard to their clinical utility, we stray away from our original aim. So, the determination of the chemotherapeutic index is now given up. When we know that the compounds are not lethal in therapeutic doses, we look in for the minor toxic symptoms produced by the drug. The chronic toxicity of the drugs in repeated doses over an extended period of time is, therefore, estimated.

## Rationalisation of Clinical Use

The clinical value of the sulpha drugs for the treatment of many bacterial infections is now well recognised even by laymen. The extent of its use can be judged by the fact that in 1943, in U.S.A. alone, nearly ten million pounds of this drug were manufactured, an unprecedented record for any chemotherapeutic agent. There are misgivings that penicillin may supersede the sulpha drugs altogether. The mechanisms of action of sulpha drugs and penicillin are different; their antibacterial spectra also differ though they overlap in certain regions. The sulpha drugs, from the point of view of cost, ease of administration, stability, storage, etc., have great advantage over penicillin, and these will decide their infiltration even into the rural areas for clinical use. There is no possibility, therefore, that the sulpha drugs would go out of use.

From 1935 onwards, about two dozen compounds have been tried clinically. If we carefully scrutinise the data, keeping the two cardinal features, cheapness and effectiveness, of the drugs as the guiding principle for selection for clinical use, we arrive at the conclusion that sulphathiazole, sulphadiazine and sulphamerazine are the best of the lot. Of the last two, sulphamerazine is preferable because its rate of excretion is much slower and its acetyl derivative is more soluble than that of sulphadiazine. Sulphamerazine can, therefore, be administered at longer intervals, and the renal damage due to it is much less. Sulphaguanidine, succinylsulphathiazole and phthaloylsulphathiazole are popular as intestinal antiseptics, because their absorption from the intestines is very little. But it appears that the same overall result could be obtained by a judicious use of sulphadiazine or sulphamerazine. As the manufacture of these three drugs are patented, attempts are being made to fabricate all types of products as possible rivals.

The important advance made in the clinical field is in the rationalisation of the therapeutics. Till the advent of the sulpha drugs, the oral dose of the drugs was taken into consideration for clinical trials, and even this dose was arrived at arbitrarily by trial and error. Now, as a rational procedure, emphasis is put on the

blood concentration attained which we know governs the therapeutic effect and of which we have definite information. So the oral dose is adjusted to maintain the optimum concentration of the free drug (5 to 15 mg. per cent. as is required) in the blood. In view of this, we can appreciate the importance of the rate of excretion of the drug from the system from the therapeutic point of view, and this property now requires as much study as the chemotherapeutic activity itself. If the drug can circulate in the system, say for two or three days, the advantages are of a far-reaching nature. The total dose to be administered will be cut down to about a sixth and, consequently, the toxic symptoms will also become negligible.

A chemotherapeutic drug which can be administered orally has great advantages. The treatment becomes very popular, not at all annoying to the patient and also very cheap. But this oral administration has other side consequences if the drugs happen to possess strong bacteriostatic action. In the treatment of systemic infections wherein the drug is required in the blood stream or tissues, by oral administration we make them reach these sites by way of the stomach and the intestines. The intestines are populated by bacteria that supply by their synthesis man's requirements of some vitamins. The sulpha drugs, while they are in the intestines for a number of days, because of repeated administration prior to absorption, kill the intestinal flora and, as a consequence, give rise to symptoms of deficiency of these vitamins. So far, we have found that the vitamins thus involved are vitamin K and folic acid. The above deficiency is particularly noticeable in the case of drugs poorly absorbed from the intestines and so have a greater destructive effect on these bacteria. This side effect should be kept in mind whenever an intensive therapy with the sulpha drugs is undertaken. Advantage has been taken of this phenomenon to study the synthetic abilities of the intestinal flora and the part they play in the vitamin supply of the system.

### Mechanism of Action of Sulpha Drugs

The unravelling of the mechanism by which the drugs act should not be considered to be of mere academic interest. The discovery of prontosil actually arose out of the wrong concept that those compounds which show activity *in vivo* should be inactive *in vitro*. This is probably derived as a converse of the observation that many compounds that show very good activity *in vitro* are inactive *in vivo* and also partly as a consequence of the lack of understanding of the difference in the mechanism of action of an antiseptic and a chemotherapeutical. Domagk vehemently held the view that the activity of prontosil is due to some action elicited by the drug from the host. As a result of subsequent extensive experiments it emerged that the bacteriostatic action of the sulpha drugs is produced by the same mechanism *in vivo* and *in vitro* by virtue of their inherent property and that they do not call upon the host for any part to play in this. The chemotherapeutic action of the sulpha drugs result from the interference with an enzyme system vitally connected with the proliferation of the bacteria. The inhibition of multiplication, rather than the instantaneous killing, appears in essence to be the mechanism of action of the sulpha drugs. Thus the interest shifted from the immuno-biological to the cytochemical and enzymic field, wherein the problem is capable of being tackled in a rational manner.

The most important advance resulted from the remarkable discovery of the specific reversal of the bacteriostatic effect of the sulpha drugs both *in vivo* and *in vitro* by *p*-aminobenzoic acid. This action is distinctly different from the reversal observed in the case of methionine, purines, peptone, etc. The theory developed by Fildes and Woods conceived *p*-aminobenzoic acid as an essential metabolite of the bacteria, the utilisation of which is prevented by the sulpha drugs by stopping the enzyme system concerned with it from functioning. The sulpha drugs show this property by displacing *p*-amino-benzoic acid from the enzyme system by virtue of the structural similarity of the two compounds concerned. Though this appeared to have solved the problem, a great deal of controversy and many issues were raised as regards *p*-aminobenzoic acid being an essential metabolite and on the mechanism of competitive inhibition. As a result of this, very fruitful work has been done.

It was found that *p*-aminobenzoic acid is a growth factor for *Clostridium acetobutylicum*, *Acetobacter suboxydans* and *Streptobacterium plantarum* and is even classed as a member of the vitamins of the B group. The exact part played by this acid in the life of the bacteria is not exactly known, though it appears to be connected with cell multiplication. We have also not identified the enzyme system involved, though it appears that the acid as such is not a prosthetic group of an enzyme or coenzyme as some conceived it. The discovery of the growth-promoting effect of *p*-aminobenzoylglutamic acid and the presence of this grouping in folic acid are significant pointers. Work in this direction is likely to throw much light on the mechanism of cell division and multiplication of the bacteria.

### Chemotherapeutic and Antiseptic Action

The mechanism of competitive inhibition has greatly influenced the imagination of the chemotherapeutists, even to the extent of making them blind to other possibilities. This gives an insight into one of the important problems in chemotherapy, *viz.*, difference between the actions of an antiseptic and a true chemotherapeutic agent. A huge number of synthetic reactions, all mediated by specific enzymes, are going on simultaneously within the same cell *in vivo* and in the bacteria. That each one of these reactions can go on as if in isolation, without being interfered by any other, has been made possible by the extreme specificity of the enzyme reactions, *i.e.*, of the substrates and the coenzymes. If the parasite lodged in the system of the host is to be selectively destroyed, this can be achieved by putting out of action one of the enzyme systems which is vital for the bacteria but differs from that of the host. Since the bacteria are versatile in syn-

thetic activities and are equipped to meet all emergencies by adaptation, they should not be capable of developing alternative pathways or other shunts to meet the needs. The true chemotherapeutic agent shows the specific selective action by the above-mentioned mechanism. The antiseptic, on the other hand, not possessing this selective action, when put in a complicated system, gets entangled in the one it comes across first and thus, going astray, is not available where its action is required. This is how the antiseptic which is very active in the test-tube looses its activity *in vivo*.

One of the ways to stop an enzyme system from functioning in a selectively specific way is by the mechanism of competitive inhibition, taking advantage of the structural specificity of the substrate of any other participant in the enzyme system. A compound which is close enough in structure to this to get involved in the first stage but not identical enough to be actually utilised in the enzyme reaction can stop the enzyme system from functioning. If this enzyme system is itself vital or a vital link in an important chain, we have obtained the typical chemotherapeutic effect. . If this effect is to be of clinical value, the additional conditions to be satisfied are: (*i*) the inhibitor should not undergo metabolisation or have affinity for other compounds *in vivo* and (*ii*) the substrate or compound being displaced by the inhibitor should not be produced *in vivo* in sufficient concentrations to nullify the action of the inhibitor itself. Though we are able to chalk out these principles in concrete terms, no great advance has been made in discovering more chemotherapeuticals because we do not know enough about the chemistry of the enzyme systems involved in bacterial multiplication and proliferation. Strangely enough, we came to know of the role of *p*-aminobenzoic acid by the reverse process of working with a true chemotherapeutic agent. Thus, the mechanism of action of the chemotherapeuticals gives us a clue to the understanding of the chemistry of bacterial multiplication.

Then there is the question as to the exact phase of bacterial growth on which the drug should act to obtain striking chemotherapeutic action—whether it should affect the respiration, metabolic or catabolic reactions, the cell division, etc. This action will decide the nature of the antibacterial effect obtained. The sulpha drugs and penicillin show their effect only when the bacteria are rapidly multiplying and not when they are in the stationary phase. Their effect is not, therefore, observed at once. This is roughly taken as a bacteriostatic action as differentiated from the bactericidal effect in which the lethal action is immediate. If an immediate chemotherapeutic effect is desired, the action of the drug must be directed against even the stationary phase of bacterial growth. We do not as yet know enough about the bacterial enzyme systems to evolve anything useful in this direction.

### Physicochemical Theory of Chemotherapeutic Action

The theory of action of the sulpha drugs, by displacing *p*-aminobenzoic acid from an enzyme system by competitive inhibition, has provided a solid base on which to build the physicochemical theory of the intensity of the chemotherapeutic effect. One fortunate fact helping us in this venture is the structural simplicity of the drugs in which the only variable is the substituent at the sulphonamide radical. So the problem is to find out how this substituent governs the degree of the intrinsic therapeutic activity. Since the mechanism involved is competitive inhibition, the more the sulpha drug resembles *p*-aminobenzoic acid the greater the degree of activity. Though the *p*-aminobenzoic acid ion and the *p*-aminobenzenesulphone radical resemble each other in geometric configuration, the only distinct feature about the former is the negative charge. So the more negative the sulphone group, the greater the activity of the sulpha-radical. The only way of gauging the negativity of the sulphone group (governed by the attached amino or substituted amino group) is by the acid dissociation constant (pKa) of the drug. The theoretical calculation shows that the maximum activity will be shown by that drug whose pKa value is 6·7. On this basis the maximum activity is almost reached in sulphathiazole (pKa=7·12), sulphadiazine (pKa = 6·48) and sulphamerazine (pKa = 7·06). That no drug has so far been discovered which shows greater activity than the above, indicates that the theoretical reasoning is sound. This is the first time in the history of chemotherapy that a physicochemical property of a compound could be used to predict its antibacterial activity. In the light of this, attempts are also being made to treat the problem on a physicochemical basis. As stated before, this has introduced a new outlook and logic in the field of chemotherapy which has earned for it the status of a science.

* The cost of printing this article has been met from a generous grant from the National Institute of Sciences, India.

## MEDIUM OF STUDIES IN COLLEGES

IN the Dominon Parliament, on the first of March, Maulana Abul Kalam Azad, Education Minister, said in reply to Seth Govind Das that as far as primary and secondary education was concerned, the Provincial Governments had accepted the principle that the medium of instruction should be the mother-tongue. Every effort was being made to put this into practice.

The Central Advisory Board of Education and the Educational Conference both came to the conclusion that the change in University education should be by stages, so that the standard of education did not suffer. It was agreed that the change-over should be spread over five years, and in the sixth year all education should be in the Indian language or languages which should be the medium of instruction. The English language would, however, continue to be a second language and a subject for post-graduate studies.

# VARIATION IN THE NORMAL PRESSURE PROFILE IN THE NEIGHBOURHOOD OF SOUTH AMERICA, THE S. W. MONSOON IN INDIA AND THE SUNSPOTS*

K. S. RAMAMURTI

## INTRODUCTION

THE author[1] has considered the effect of the variations in the distribution of pressure departures over South America on the Indian Monsoon in a paper entitled "An Analysis of the Influence of the South American Pressure on the Indian Monsoon". The normal pressure distribution over the South Atlantic during April and May has a maximum at latitude 30° S. and a minimum at the equator and at latitude 60° S. A curve with the least number of constants to represent these conditions will be

$$P = \overline{P} + R\,\{\sin 6\,(\phi - 15^\circ) - \overline{S}\} \qquad (1)$$

where P is the pressure in mm, $\phi$ latitude in degrees, R an arbitrary constant and $\overline{P}$ and $\overline{S}$ are the means of P's and the value of $\sin 6(\phi - 15^\circ)$ in the given range. It can be seen that $\overline{S} = 0$ for the range $0 \leqslant \phi \leqslant 60^\circ$. The author has fitted a similar curve,

$$p = \overline{p} + r\,\{\sin 6\,(\phi + \epsilon) - \overline{s}\} \qquad (2)$$

by the method of least squares to the average departures of pressure in April and May at various latitudes and considered the effect of the changes in $\overline{p}$, $r$ and $\epsilon$ from year to year on the monsoon rainfall of the corresponding year in the Peninsula and N.W. India.

The Peninsula consists of Bombay, C.P., Hyderabad and North Madras Coast. N.W. India comprises West U.P., East and North Punjab, Kashmir, N.W.F.P., and Rajputana to which S.W. Punjab has been added because of its geographical position; but as the rainfall in this division is not representative of the rainfall in the remaining subdivisions, half-weightage has been given to it while giving the divisions weights proportional to their areas.

It has been found that $\overline{p}$ and $\epsilon$ in equation (2) above have significant relationship with the Indian Monsoon. Their multiple C.C. with the monsoon rains in the Peninsula and N.W. India are 0·36 and 0·59 respectively. It has also been shown that South American pressure, mean of Santiago, Buenos Aires and Cordoba which is being used by the India Meteorological Department to forecast the monsoon rainfall in the Peninsula and N.W. India, combines in itself to an extent the effects of the change in the mean pressure, $\overline{p}$ and the shift of the pressure pattern, $\epsilon$. But $r$ has practically no relationship with the monsoon rains in India.

The object of this note is to study the influence of the variations in the normal pressure profile during April and May, *viz.*, the variations in the parameters $\overline{P}$, R and E of the curve,

$$P = \overline{P} + R\,\{\sin 6\,(\phi - E) - \overline{S}\} \qquad (3)$$

on the monsoon rains in India. The relationships among the parameters and the sunspots are also studied. The high pressure belt will now have its axis on latitude (E + 15) degrees and the low pressure area will be at latitudes (E − 15) and (E + 45) degrees. It may be seen that the value of E for the distribution of normal pressure in South America and neighbourhood is 15° S.

## SOURCE OF DATA AND METHOD

The pressure departures at various latitudes used in the previous paper as well as in this note were computed as follows:

Pressure data were available for 19 stations in S. America in the World Weather Records[2] (1927 and 1934). All the stations whose latitudinal positions were near each other were grouped together and the mean departures of these groups were taken to be the pressure departure at their mean latitude corrected to the nearest half a degree.

In any given year, suppose that the pressure at latitude $\phi$ degrees has a value $(P + \delta P)$ mm., *i.e.*, $\delta P$ is the pressure departure at latitude $\phi$ degrees, and that this set of changes of pressure at different latitudes necessitated corresponding changes of $\partial\overline{P}$, $\partial R$ and $\partial E$ is in the parameters of the curve (3), where $\partial E$ is radian measure. Then,

$$\partial P = \partial\overline{P} + \partial R \sin 6\,(\phi - E) - R \cos 6\,(\phi - E)\; 6\,\delta E \qquad (4)$$

Now substituting E = 15°, the equation reduces to

$$\partial P = \partial\overline{P} - \partial R \cos 6\,\phi - 6\,R\partial E\cdot\sin 6\,\phi \qquad (5)$$

where $\delta P$ is the pressure departure at latitude $\phi$ and $\delta\overline{P}$ is the mean of these departures between latitudes 0° and 60° S. Thus, the corrections to the parameters of the normal curve to represent the pressure distribution in a given year are got by fitting an equation of the type

$$p = \overline{p} + \alpha \cos 6\,\phi + \beta \sin 6\,\phi \qquad (6)$$

to the pressure departures. Then

$$\overline{p} = \partial\overline{P},\ \alpha = -\,\partial R \text{ and } \beta = -\,6\,R\,\partial E \qquad (7)$$

Curves of type (6) have been fitted for the departures of pressure at various latitudes during April and May of each year in the paper mentioned above.[1] The values of the parameters are also given in the same paper.

It is evident that $\overline{p}(\delta\overline{P})$ is a measure of the excess transport of air to the southern hemisphere in the neighbourhood of South America over the normal transport for the season and

* Read in the 1948 session of the Indian Science Congress.

$\delta E$ is the shift of the high pressure belt (but not the shift $\epsilon$ of the superposed pattern as in the previous paper).

To find the effect of the variations in $\delta\bar{p}$, $\delta R$ and $\delta E$ on the Southwest Monsoon in India, $\bar{p}$, $\alpha$ and $\beta$ were, therefore, correlated with the June to September rainfall in the Peninsula and N.W. India and these together with the intercorrelations are given in Table I.

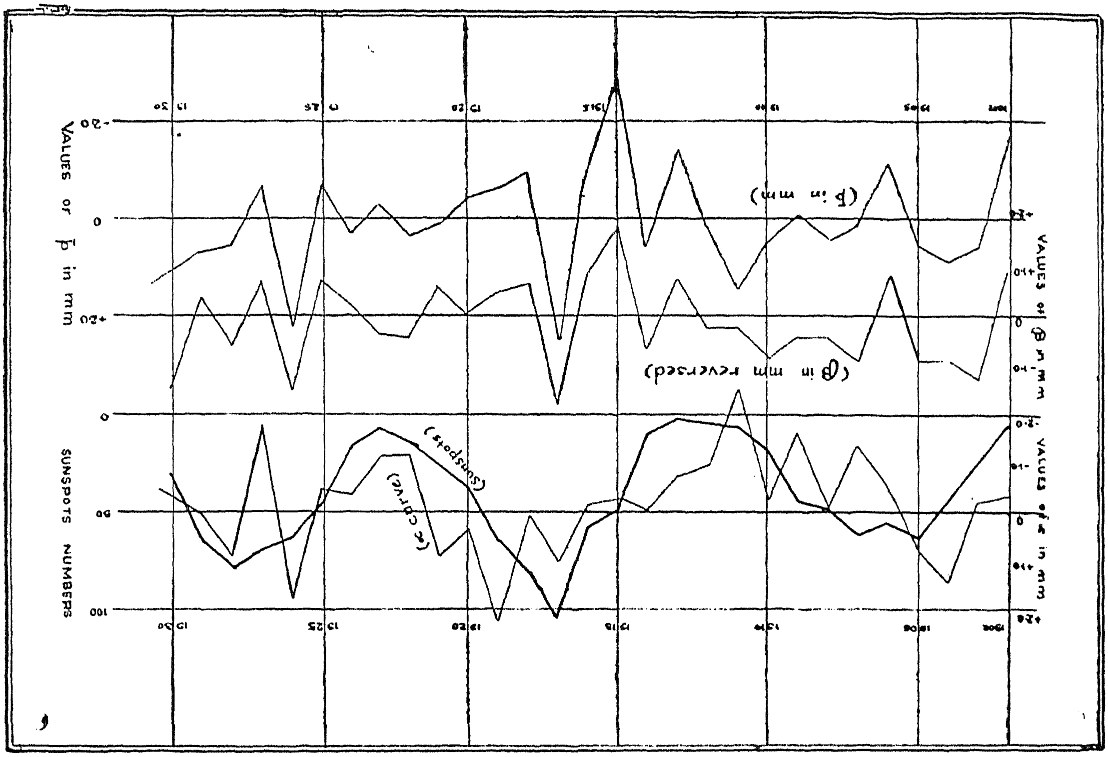


TABLE I

| | $\beta$ | $\bar{p}$ | June to September rainfall in | |
|---|---|---|---|---|
| | | | Peninsula | N.W. India |
| $\alpha$ | $-0\cdot19$ | $+0\cdot23$ | $+0\cdot11$ | $+0\cdot16$ |
| $\beta$ | | $-0\cdot87$** | $-0\cdot22$ | $-0\cdot31$ |
| $p$ | | | $+0\cdot22$ | $+0\cdot41$* |

* Significant at 5% level.
** Significant at 1% level.

## DISCUSSIONS

The multiple C.C. of $\bar{p}$, $\alpha$ and $\beta$ with the Peninsula rainfall is 0·24 and with N.W. India rainfall 0·43. Both these values are not very much different from the C.C.'s of $\bar{p}$ alone with them. The C.C. of $\bar{p}$ with N.W. India rainfall is significant at 5 per cent. level and that of $p$ with $\beta$ at 1 per cent. level. The rest of the C.C.'s are not significant.

The above results show that a consideration of the variation in the latitudinal distribution of pressure does not give any further information about the monsoon than what $\bar{p}$ gives. But it was shown that $\epsilon$, the shift of superposed pattern—that is, the variation in the pattern when the normal distribution of pressure has been taken to be the base line, or again, when the trend in the variation of pressure with latitude has been eliminated—gives additional information on the subsequent monsoon in India.

The above fact is also demonstrated by the Analysis of Variance technique. Let the corrected sum of squares (of 29 years) of N.W. India June to September rainfall be $s^2$. The sum of squares due to regression is $R^2s^2$ where R is the simple or multiple C.C. according as one or more independent variables are considered. Tables II($a$) and II(b) give the sum of squares due to $\bar{p}$, $\epsilon$ and $r$ and due to $p$, $\alpha$ and $\beta$ respectively.

TABLE II($a$)

| S.S. due to | D.F. | Sum of squares | Mean square | F |
|---|---|---|---|---|
| $p$ | 1 | $0\cdot1681\ s^2$ | $0\cdot1681\ s^2$ | 6·57* |
| $\epsilon$ | 1 | $0\cdot1800\ s^2$ | $0\cdot1800\ s^2$ | 7·03* |
| $r$ | 1 | $0\cdot0119\ s^2$ | $0\cdot0119\ s^2$ | |
| Residual | 25 | $0\cdot6400\ s^2$ | $0\cdot0256\ s^2$ | |
| Total | 28 | $1\cdot0000\ s^2$ | | |

TABLE II(*b*)

| S. S. due to | D.F. | Sum of squares | Mean square | F |
|---|---|---|---|---|
| $\bar{p}$ | 1 | $0\cdot1681\ s^2$ | $0\cdot1681\ s^2$ | 5·16* |
| $\alpha$ | 1 | $0\cdot0045\ s^2$ | $0\cdot0045\ s^2$ | |
| $\beta$ | 1 | $0\cdot0123\ s^2$ | $0\cdot0123\ s^2$ | |
| Residual | 25 | $0\cdot8151\ s^2$ | $0\cdot0326\ s^2$ | |
| Total | 28 | $1\cdot0000\ s^2$ | | |

* Significant at 5% level.

Another important point brought out by the C.C.'s (Table I) is the extremely significant negative relationship between $\bar{p}$ and $\beta$ and, therefore, the high positive association between $\bar{p}$ and $\delta$E. That is, between $\bar{p}$ and E$p$. The values of $\epsilon$ and $\bar{p}$ have been plotted on a graph. The high order of correspondence between $-\beta$ and $\bar{p}$ can be seen from the chart. This means, that the more the import of air into the South Atlantic region the farther will the axis of high pressure belt be shifted from the equator. *That is, the equatorial cell of the meridional circulation expands longitudinally with advection of air.*

SUNSPOTS $p$ $\alpha$, $\beta$ ETC.

The values of $\alpha$, $-\beta$ and $\bar{p}$ have been charted on a graph (see chart). The mean annual observed sunspot numbers for the corresponding years as given by Brunner[4] (1939) are also charted along with the $\alpha$-curve. It may be seen that the graph of $\alpha$ follows fairly closely the graph of sunspot numbers. The C.C.'s have been worked out between the annual mean sunspot numbers and the values of $\alpha$, $\beta$, $\bar{p}$, $\epsilon$ and $r$ of the corresponding year. These are tabulated below:

| | $\alpha$ | $\beta$ | $\bar{p}$ | $\epsilon$ | $r$ |
|---|---|---|---|---|---|
| C.C. of mean annual sunspot numbers with | +0·44* | −0·12 | +0·18 | +0·34 | +0·22 |

* Significant at 5% level.

$\alpha$ has a significant positive correlation with the mean annual sunspot number of the corresponding year. Since $\alpha = -\delta$R, R the amplitude of the normal pressure profile in the South Atlantic decreases with increasing sunspots. Perhaps this could be explained by a sympathetic circulation induced in the earth's upper atmosphere by the circulations in the sun which are seen as sunspots.

1. Ramamurti, K. S., "An Analysis of the Influence of the South American Pressure on the Indian Monsoon" (to be published by the India Met. Department). 2. World Weather Records, *Smith. Misc. Coll.*, 1927 & 1934, **79**, and **90**. 3. Snedecor, G. W., Statistical Methods, Collegiate Press, *Inc. Am s. Iowa*, 1946. 4. Brunner, W. *Terrestrial Magnetism and Atmospheric Electricity*, 1939, **44**, 3.

*Note.*—The cost of printing this article has been met from a generous grant of the Indian Council of Agricultural Research, New Delhi.

## SOME DEVELOPMENTS IN FERROUS METALLURGY *

THAT the world has consumed more metals during the first twenty-five years of this century than in all preceding time strikingly illustrates the predominant position held by metals in modern industrial civilisation. Amongst the metals, iron and steel, by virtue of their versatility, potential supply and low cost of production hold an unrivalled place among industrial materials. Some recent developments in the iron and steel industry, arising from advances in scientific knowledge and technique, leading to the production of more and better steels for general and special purposes have been considered in the address delivered by Mr. N. Sen to the Section of Engineering and Metallurgy at the Indian Science Congress at Patna.

Amongst the more important developments in the production methods of iron and steel and of their products may be cited (1) the adoption, where applicable, of the so-called "acid-burning process", where the use of an acid slag (lime to silica ratio of about 0·9) considerably diminishes the coke consumption; (2) the use of ore crushed to pieces less than about ¼ inch, which enables the ore to be reduced by carbon monoxide higher up the blast furnace than otherwise and thus leading to increased carbon efficiency; (3) the use of oxygen in the blast furnace and the open hearth to enrich combustion mixture as well as for carbon reduction in the latter (a laboratory development as yet, which promises to find immense application in industry); (4) the use of electromagnetic circulation of the metal in the electric arc furnace by installing specially disposed coils in the hearth of the furnace and thereby increasing the homogeneity and speed of desulphurisation of high alloy steels; (5) the increasing adoption of electric iron smelting and of low temperature hydrogen reduction followed by electric melting of the sponge-iron cake produced in the first instance (a development of particularly great importance in India, because of the high potential resources of hydroelectric power and the restricted reserves of metallurgical coal); (6) the adoption of rolling processes for the production of weldless tubes; and (7) improvements in the casting, forging and allied operations.

* Extracts of Presidential Address delivered by Mr. N. Sen, to the Section of Engineering and Metallurgy at the 35th Session of the Indian Science Congress at Patna, 1948.

Developments leading to the production of improved quality, and special steels based on increased understanding of the main causes of the chief defects occurring in steels, *viz.*, piping, segregation, inclusions, blowholes, etc., and of the specific characteristics of steel required to meet a specific purpose, have been no less striking than the developments in production technique. Amongst these may be given as examples (1) studies of the law of Mass Action leading to a clearer understanding of slag-metal reactions, and of Ingot design, pouring temperature and technique, resulting in the production of "cleaner" and "sounder" steels; (2) improved methods of inspection and non-destructive testing of cast, welded, forged and otherwise fabricated material by X-ray, supersonic and magnetic testing methods; (3) studies of isothermal transformations, *i.e.*, of the transformation at various constant temperatures of steel, initially in the austenitic condition, and of the hardenability of steel which have made possible the production of heat-treated members of large sections and have also led indirectly to the conservation of valuable alloying elements, as the influence of the latter on steel has been shown to be more multiplicative than additive; (4) development of permanent magnet and high permeability steels, and application of 'Powder-metallurgy' techniques (pressing and sintering of metal powders) for the production of permanent magnets of small sizes and intricate shapes; (5) development of corrosion-resisting and stainless steels by studies of the thin films formed on their surface by electron-diffraction and other methods and of creep-resisting steels; and (6) development of X-ray crystallography and the mathematical theory of metals, which have led to an understanding of the principles of alloying and of the formation of intermetallic compounds in metals.

In conclusion, it may be said that while metallurgy may have been for long an art, it has become a science only recently. It is at an exciting stage of development, and we can confidently look forward to a period when alloys for specific purposes can be "made to order"; at the same time, the increased knowledge will enable us to utilise better the alloys that we already possess and to conserve those elements, the reserves of which are limited.

E. G. RAMACHANDRAN.

---

# OUTLINE OF SOME MODERN THEORIES OF STATISTICAL INFERENCE*

SPEAKING on the above subject Mr. S. N. Roy reviewed the recent developments within the last 25 years in the theory of statistical inference as worked out by Fisher, Neyman, Pearson, Wald and other statisticians.

After defining the subject as dealing with "inferences made from a sample of actual observations—either pure random or random under qualifications—about the universe sampled", he started with a set of $n$ stochastic variables ($x_1\ x_2\ \ldots\ x_n$) (sometimes written for shortness as $[x^{(n)}]$) and a similar symbol $[\theta^{(k)}]$ for parameters $\theta_1, \theta_2 - \theta_k$ with a probability distribution

$\phi\ (x_1, x_2, \ldots\ x_n\ ;\ \theta_1, \theta_2, \ldots \theta_n) \prod_{i=1}^{n} dx_i$, (in the case of continuous variables) on simply $\phi\ (x_1, x_2, \ldots\ldots x_n, \theta_1, \theta_2, \ldots\ \theta_n)$ in the case of discrete variables;

The main objectives in the case of any general $\phi$ are:—

"(*i*) Inference about $\phi$ covering both its forms and parameters $\theta^{(k)}$ this inference being made in the light of $[x^{(n)}]$ of which a special but important case is (*a*) inference about $\theta^{(k)}$ assuming $\phi$ to be a known form, and

(*ii*) testing again on the basis of $[x^{(n)}]$ any hypothesis concerning $\phi$—both form and $[\theta^{(k)}]$ of which a special case is (*ii*) (*a*) testing any hypothesis about $[\theta^{(k)}]$ assuming the form of $\phi$ to be known."

It was later shown how the Fisher's theory of point estimation and the Neyman and Pearson's theory of testing hypothesis help us in solving these problems. In connection with the latter theory, the parametric cases with simple hypothesis and the parametric cases with composite hypothesis were also discussed.

There can be instances in the parametric cases where the uniformly most powerful tests even in the limited sense do not exist. Even though the most powerful tests with regard to a particular alternative hypothesis and a corresponding confidence interval may exist, it will not answer the question what a particular hypothesis or estimate is worth "*vis-a-vis* the totality or a suitable sub-totality of other possible alternatives or estimates". The contributions of Dr. Wald towards solving such a question consist in the asymptotically most powerful tests and shortest confidence intervals. The most powerful tests on an average are also indicated.

Dr. Wald's general and unified theory of statistical inference not only broadens the basis of both estimation and testing of hypothesis, but also fuses both into a remarkable synthesis. The speaker gave a short but illuminating picture of this theory and also of his (Dr. Wald's) latest contribution, the technique of sequential analysis.

M. C. SATYANARAYANA.

* Extracts from the Presidential Address of Mr. S. N. Roy, to the Section on Statistics, at the Indian Science Congress, Patna, 1948.

# MINERAL SPRINGS OF INDIA*

FOR the first time, a comprehensive report on the mineral springs of India in its various aspects has been presented by Dr. P. K. Ghosh from the presidential chair of the Geology Section of the Indian Science Congress. Mineral springs are of considerable importance in European countries; and at the present time, many of the localities where mineral springs have been noted are centres of flourishing commercial enterprises. Many of these localities in Central Europe have become world famous; and water from such localities is bottled and sold in all parts of the globe on account of its reputed medicinal properties.

Unfortunately in India, except for occasional publications that have appeared on and of, no systematic work has been done. Up-to-date information regarding mineral springs is meagre, although the country is known to possess a large number of natural springs.

Though Sir Thomas Holland had pointed out the importance of the study of mineral springs as early as the commencement of this century, yet, not much work was done till 1939, when Dr. Sir Cyril Fox took up the problem for detailed investigation.

A general study of the geology of the springs in India has shown that they are located in groups along certain definite lines, and these lines correspond with directions of major faults in the area. In limestone areas springs occur in the joint planes and solution channels. Springs in valleys generally indicate the local ground-water level. Again a study of the distribution of these springs in India show certain broad belts to which they are confined, and detailed study has shown that these groups of springs are invariably related to major geological changes that have taken place in India. The following classification shows the intimate relationship that exists between springs and geological structure of the country.

1. (*a*) Mineral springs of Bihar, which are more or less parallel to the coalfield boundaries; (*b*) mineral springs of Rajgir area; (*c*) mineral springs of Monghyr area. These are closely related with the east and and west post-Gondwana faults.

2. Mineral springs of west coast of India such as of Ratnagiri, Kolaba, Thana and Surat districts of Bombay.

3. Those of Sind and Baluchistan.

Springs belonging to the above two areas are intimately related with the meridional dislocations during the tertiary period.

4. The mineral springs associated with the Himalayan belt. These are due to local orogenic causes. These conclusions have been further strengthened by the discovery of zones of crushing and brecciation near sites of mineral springs.

The chemical composition of the spring waters varies according to the nature of the country rock through which it flows. Those found in Archæan terraines are fairly highly radio-emanative and of low mineral content. Those emerging from the basaltic regions are low in radium emanations, but are rich in alkaline earths, sulphate and chloride radicals. Springs emanating from limestone areas are rich in calcium, bicarbonate, carbonate and sulphate radicals.

There are different kinds of springs, some are cold, others are luke-warm and still others are boiling hot. The temperature of these springs have always been constant. The flow of water is generally large during the rains, and meagre during summer. The hot springs do not show much variation. Majority of the cold water springs draw their source of water from the surface collections, but hot water springs are supposed to draw their supply from deeper regions. .

Mineral spring waters may be either temporarily or permanently radio-active. The Indian waters investigated are only temporarily radioactive, and this is due to the presence of radon in solution in microscopic quantities derived from the disintegration of radio-active minerals in rocks.

Many of the spring waters are charged with soluble salts in fairly large proportions, and the chief of them are sulphates of magnesium and sodium, bicarbonates and chlorides of alkalies and alkaline earths. Some of them also contain iodides and bromides, and consequently many of them are credited with therapeutic values. A fairly large number of Indian spring waters compare very favourably with foreign waters in composition. The analyses of a large number of Indian spring waters can be grouped as follows.

(1) Simple waters of low mineral contents.
(2) Alkaline waters characterised by soda and bicarbonate radicals.
(3) Sulphur waters charged with $H_2S$ and sulphide and sulphate radicals.
(4) Chloride or saline water.

In the concluding portion of his address, Dr. P. K. Ghosh has tried to speculate on the source of heat for the hot water springs of India. In so far as these springs of C.P. and Bihar are concerned, he has made the suggestion that the juvenile waters associated with the latest phase of the igneous activity, namely, the Deccan trap, may be the possible source. Though other alternatives are considered, it is presumed that the main source of the heat must be the juvenile waters associated in such large quantities with the magma chambers in the deeper portions of the Earth.

M. R. SRINIVASA RAO.

* Presidential Address of Dr. P. K. Ghosh to the Geology Section of the Indian Science Congress, Patna, 1948.

## SEXUAL PERIODICITY IN INDIAN BIRDS*

PROFESSOR A. B. MISRA of the Hindu University, Benares, has chosen for his presidential address to the Zoology Section of the Indian Science Congress, a most fascinating subject, a subject in which he has been a pioneer worker in India. He has been engaged in the study of the sexual periodicity among Indian birds for the last twelve years and has investigated no less than twelve species. The results of the author have abundantly shown that the accepted views about sexual cycle are not applicable to all the members of the avifauna in all climes.

The male reproductory glands of the common Mynah (*Acridotheres*) show maximum size in May-June and afterwards there is a decline. Microscopic examination also shows that during May-June, the sperma-teleosis is in full swing. A very important phenomenon has been noticed during these progressive changes in the testes of the birds examined at Benares. A large number of cells appear suddenly in the tunica vasculosa and transgress not only into the intertubular areas where they behave like interstitial cells, but also into the tubules to transform themselves into sperms. Then, during the downward phase of the cycle an elimination of some 'weak and incompetent cells' takes place within the tubules. Thus, there is not only an annual reinforcement of extraneous cells into the tubules for the manufactory of sperms but also an elimination process. The interstitial cells become prominent after the spermatogenic wave.

While the majority of birds conform in their sexual periodicity to a general plan, birds like *Tyto* and *Bubo*, however, reach their reproductive climax during October and December respectively. Naturally this leads us to question why there should be such seasonal differences.

* Abstract of Prof. A. B. Misra's Presidential Address before the Zoology Section of the Indian Science Congress, 35th Session, Patna, 1948.

It has been pointed out that environmental factors like light, ultraviolet radiation, temperature, rain and food may be potent causes. But in a country like India which is abundantly endowed with this source of energy all through the year, light may not be so important; even with regard to the effect of actinic rays, the two exceptions mentioned above preclude us from accepting it as a causal factor; similarly temperature may be playing only a secondary role. While food is essential for maintaining proper health, it has been argued that it cannot be regarded as a conditioning factor, thereby differing from the observations of Baker and Marshall.

While some birds are profoundly affected by the environmental influences, internal rhythm predominates in others. Baker's correlation between internal rhythm and ecology become questionable when applied to vertebrates like mammals, and, therefore, it is 'idle to speculate on the nature of the sexual rhythm or its relationship with the environment'.

The beak colour as influenced by the endocrine secretions has been noticed in a few Indian birds like Cattle Egret, Water-hen, etc.

With regard to the important question of mitosis, it is noticed to take place all through the day, unlike in the English sparrow in which it occurs only during the early hours of the morning. Amitosis and abnormal sperms are not uncommon.

Finally, it has been pointed out that a complex of multiple physiological factors like the geneic control of the endocrine glands, the activation of the gonads, susceptibility of the soma to the endocrine influences, selective responsiveness of the organism to the external environmental factors and the accumulated effect of the environment upon the organism seem to be instrumental in governing the sexual cycle in birds, and many, if not all, of these require further elucidation.

L. S. R.

## COSMIC RAY CONFERENCE

A CONFERENCE on Cosmic Rays was held, October 6 to 11, 1947, in Cracow, Poland.

More than 15 papers were read during the 9 sessions, one of which was held 100 meters underground, at the salt mines of Wieliczka. The discussions following each session were not limited in time in order to permit full exchange of ideas and information.

Besides the general conference, two special sessions of the Cosmic Ray Commission of the International Union of Physics were held to discuss special problems of interest in the field of cosmic radiation.

Several resolutions were passed. One looked toward a conference of the Commission to be held in Europe in the period July 1 to September 7, 1949. A second, given in full below, dealt with names for the elementary particles. A third authorized the preparation and publication of a small pamphlet to list men and laboratories all over the world concerned with problems of cosmic-ray physics. It was arranged that any suggestions made in this latter connection should be sent to Prof. Pierre Auger in Paris.

Among the subjects discussed during the Conference were the new discoveries of Dr. Powell, of Bristol, of two types of mesons; the theoretical interpretation of experiments on Cosmic Rays, by Dr. Heitler and Dr. Wheeler; the extensive atmospheric showers (Auger showers), the penetrating showers, and the nature of cosmic-ray particles.

*Resolution on Names for the Elementary Particles*

The Cosmic Ray Commission of the International Union of Physics at its meeting in Cracow (October 9, 1947):

(1) Recognizes the convenience of uniform names for the elementary particles.

(2) Recognizes that it may be undesirable to make an official recommendation on name in any particular case until widespread usage justifies such a recommendation.

(3) Notes that the term *nucleon* has found quite general recognition as a common term to denote both neutrons and proton.

(4) Recommends, therefore, that the term *nucleon* receive official recognition for this purpose.

# LETTERS TO THE EDITOR



## POSSIBLE USE OF FREQUENCY CURVES IN THE CLASSIFICATION OF GYROGONITES*

A small collection of about 200 Gyrogonites separated out from the Intertrappean cherts collected by Prof. C. Mahadevan from Chittampalle near Vicarabad in Hyderabad State, was divided on the basis of general shape into 7 groups of which 4 had the following numbers:

Group 1—33, Group 2—58, Group 3—28, Group 4—40.

The variation in length in each of the above groups was plotted against frequency and the curves yielded the following data:—

| | Smallest length | Greatest length | Mode or modes |
|---|---|---|---|
| Group 1 .. | 480 μ | 720 μ | 590 μ |
| Group 2 .. | 420 μ | 720 μ | 565 μ |
| Group 3 .. | 480 μ | 960 μ | 630 μ & 850 μ |
| Group 4 .. | 540 μ | 780 μ | 540 μ (?) & 720 μ |

Harris[1] has given the curve for variation in length of the fructifications of *Chara vulgaris*, it is a normal curve. The curves for the first two groups are normal and might reasonably be supposed to belong to one species each. Group 3 shows two maxima at 630 μ and 850 μ. It appears to be logical to infer that each mode stands for one species. In Group 4, however, there being no specimen shorter than 540 μ, 540 cannot be taken as a mode but 720 μ is a mode value and from the curve it is clear that if 540 μ does not represent the mode, there ought to be one, smaller than that. However, this remains to be applied to a large and varied collection of *Gyrogonites*, and the result studied.

My thanks are due to Professor C. Mahadevan of Andhra University under whose direction the work was carried out, to Mr. Syed Kazim, Director of Mines and Geological Survey, Hyderabad (Deccan), for permission to work on the materials, and Dr. J. Venkateswarlu, Botany Department, Andhra University, for his suggestions.

Geological Survey Dept.,
Hyderabad (Dn.), S. R. Sarma.
*January* 3, 1948.

1. Harris, T. M., *British Purbeck Charophyta*, 1939

* Contribution from the Geology Department of the Andhra University.

## PRESENCE OF GALLIUM IN MICAS AND SCHISTS

It is generally known that gallium is present in very small amounts in certain minerals, chiefly zinc blende, which forms one of the richest sources for this element. It is also present in certain iron ores and in almost all the ores of aluminium. But in these ores it occurs more or less as a trace element and can be detected only by spectroscopic methods. Under these circumstances the following observations on the spectroscopic analysis of certain micas and schists will be of some interest.

In the Nagpur district there are the Kandri and the Mansar mines well known for their rich manganese deposits. The manganese ores consist typically of "mixtures of bauxite and psilomelane, and occur as bands of considerable length intercalated between gneisses, schists, etc." These schists were examined spectroscopically for their composition, with special reference to the presence of trace elements. A five-foot concave grating was used for taking the spectra. The instrument gave a dispersion of about 11 A° per mm. at λ-4200, in the first odrer.

The following is the list of the very prominent lines in the spectrum taken with pure carbon electrodes. The lines due to impurities in the electrodes have been omitted.

| Wave-length | Int. | Origin | Wave-length | Int. | Origin | Wave-length | Int. | Origin |
|---|---|---|---|---|---|---|---|---|
| 5535·5 | 100 | Ba I | 4289·7 | 6 | | 3968·5 | 8 | Ca II |
| | | | 4274·8 | 8 | Cr I | 3961·5 | 30 | Al I |
| 5183·6 | 20 | | 4254·3 | 8 | | 3944·0 | 30 | Al I |
| 5172·7 | 10 | Mg | | | | 3933·7 | 8 | Ca II |
| 5167·3 | 10 | | 4226·7 | 30 | Ca I | | | |
| | | | 4215·5 | 6 | Sr II | 3838·3 | 10 | |
| 5014·3 | 6 | | | | | 3832·3 | 8 | Mg |
| 5007·2 | 6 | | **4172·1** | **6** | **Ga** | 3829·4 | 4 | |
| 4999·5 | 6 | Ti | | | | | | |
| 4991·1 | 6 | | 4077·7 | 6 | Sr II | 3653·5 | 4 | |
| 4981·7 | 6 | | 4047·2 | 8 | K | 3642·7 | 4 | Ti |
| | | | 4044·2 | 8 | K | 3635·5 | 3 | |
| 4934·1 | 10 | Ba II | | | | | | |
| 4607·3 | 10 | Sr I | 4034·4 | 6 | | 3593·5 | 6 | Cr I |
| 4554·0 | 20 | Ba II | 4033·0 | 8 | Mn | 3578·7 | 6 | Cr I |
| | | | 4030·7 | 8 | | | | |
| 4434·9 | 5 | | | | | 3273·9 | 10 | Cu I |
| 4318·6 | 4 | Ca I | 3998·6 | 6 | | 3247·6 | 10 | Cu I |
| 4302·5 | 6 | | 3989·8 | 6 | Ti | | | |
| | | | 3981·8 | 6 | | 3096·9 | 2 | Mg I |
| 4301·1 | 3 | .i | | | | | | |
| 4300·6 | 3 | Ti | | | | 3092·8 | 10 | Al I |
| | | | | | | 3082·2 | 10 | Al I |

It will be seen from the above table of wavelengths that, besides the common elements known to be present in the basic rocks and schists, the specimen under investigation shows the strong line, characteristic of gallium. The prominent lines of gallium as given in the wavelength tables published by the Massachusetts Institute are as follows :—

4172·056 Int. (Arc) 2000 R  2943·637 Int. (Arc) 10
4032·982 ,, ,, 1000 R  2874·244 ,, ,, 10

Kayser's wavelength tables give the following sensitive lines for gallium :

| | | | |
|---|---|---|---|
| 4172·05 | 10 R | 2943·64 | 2 |
| 4033·01 | 10 R | 2874·24 | 2 |

The pair in the ultra-violet is too faint to be obtained on the plate. The line at 4033 coincides almost with the central line in the Mn triplet which is one of the "Raies Ultimes" of manganese.

Several specimens of mica, including one obtained from Korhadi (a few miles from Nagpur) were examined. They all showed the unmistakable presence of the gallium line, the intensity of which depended on the specimen studied. But amongst the specimens investigated, by far the greatest intensity of the line was observed in the bauxite ores of the Central Provinces. It is very doubtful if the extraction of the element from these ores will be a possibility. At least it will be possible to extract a greater concentration for spectroscopic study and confirmation.

As the identification of the element depended practically on the single line at 4172, the experiments were repeated using spectroscopically pure copper electrodes and specimens of very clear mica, assumed free from Mn. Though the Mn triplet was considerably reduced in intensity, yet it could not altogether be eliminated. However, it was significant that in some plates the intensity of the middle component was more than that of the outer components of the triplet.

As a result of a large number of measurements on different plates the mean wavelength of the gallium line was found to be 4172·07 ± ·03 A°.

Mahakoshal Mahavidyalaya,
Jubbulpore, A. S. Ganesan.
*February* 4, 1948.

## THE USE OF SODIUM CHLORIDE IN THE DETERMINATION OF ACID VALUES OF CELLULOSIC MATERIALS

Neale and Stringfellow[1] suggested the use of aqueous sodium chloride in the determination of acid values of cellulosic fibres; they added an excess of N/50 caustic soda and titrated back the alkali with N/50 sulphuric acid in presence of bromocresol purple. Hiller and Pacsu[2] consider the presence of sodium chloride unnecessary when phenolphthalein is used as indicator. In the case of jute fibre, however, it has been observed that the amount of excess alkali must be very small, abnormally high values being otherwise obtained.[3] It was found that direct titration of the fibre (previously freed from cationic ash) suspended in sodium chloride solution with caustic soda in presence of bromothymol blue was the best procedure. Sodium chloride of analytical reagent quality in boiled-out distilled water gives a solution neutral to B.D.H. universal indicator. This was employed in all of our experiments. Direct titration of jute fibre in carbon dioxide-free distilled water with dilute caustic soda in presence of phenolphthalein (no excess alkali being added) is rather tedious; the acid is neutralised very slowly towards the end. With sodium chloride, no such difficulty arises; the best indicator being bromothymol blue (or phenol red), for we are in this case actually titrating a strong acid (HCl) with very dilute (N/50) caustic soda. Due to its higher pH range for colour change, phenolphthalein is unsuitable, a higher value being obtained in its presence. The following table will show that there is fairly close agreement between the results with and without sodium chloride in presence of bromothymol blue and phenolphthalein respectively. The former is unsuitable as indicator for weak acids like cellulosic or uronic acids (due to its lower pH range for change of colour); lower acid values are thus obtained.

TABLE I

*Acid value of Jute Fibres with different indicators and with and without NaCl*

| Material | Acid value | | | |
|---|---|---|---|---|
| | phenolphthalein | | bromothymol blue | |
| | with NaCl | without NaCl | with NaCl | without NaCl |
| Defatted jute treated with N/10 HCl and washed neutral | 12·4 | 11·2 | 11·7 | 8·9 |
| Defatted jute treated with 1% NaOH at room temp. and then with N/10 HCl and washed neutral | 25·8 | 23·0 | 22·4 | 18·1 |
| Chlorite holocellulose from defatted jute | 24·6 | 21·5 | 22·1 | 17·8 |

Acid values obtained with silver ortho-nitrophenolate or potassium iodide and iodate, it may be noted, agree well with those in column four.[3]

P. B. SARKAR.
A. K. MAZUMDAR.
K. B. PAL.

Tech. Res. Laboratories,
Indian Central Jute Committee,
Regent Park, Tollygunge,
Calcutta,
*December* 5, 1947.

1. Neale and Stringfellow, *Trans. Faraday Soc.*, 1937, **33**, 881. 2. Hiller and Pacsu, *Text. Res. J.*, 1946, **16**, 390. 3. Sarkar, Chatterjee and Mazumdar *J. Text. Inst.*, 1947, **38**, T. 318.

## ORGANO ARSENICALS—

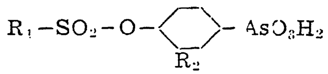
### Aryl Sulphonyl Esters of Hydroxyphenyl Arsonic Acids

IN view of the therapeutic importance of Organo Arsenicals, systematic investigations on the synthesis of new arsenicals for pharmacological studies have been in progress in our Laboratories.[1] A survey of the literature showed that very little study has been made of the aryl sulphonyl esters of hydroxyphenyl arsonic acids, one instance being the preparation of p-toluene sulphonyl ester of 3-nitro-4-hydroxyphenyl arsonic acid by Benda and Bertheim.[2]

Eighteen sulphonyl esters (*vide* table below) of the general formula (I) have been prepared by the action of benzene-, p-toluene, p-chlorophenyl-, p-acetaminophenyl- and β-naphthalene-sulphonyl chlorides on 4-hydroxy-, 3-nitro-4-hydroxy- and 3-acetamino-4-hydroxy-phenyl arsonic acids and characterised. The reactions were conducted in sodium carbonate solution either at ordinary temperature or at 80° C., the products isolated by acidification and purified by crystallisation from organic solvents. Compounds 2, 6, 10, 13, 14 and 18 were prepared by hydrolysing the corresponding acetamino products with acid. Long after our work was completed, Fox[3] has recently reported the preparation of 3-amino-4-[(p-acetamino)- and and (p-amino)-benzenesulphonyl-oxy] phenyl arsonic acids.

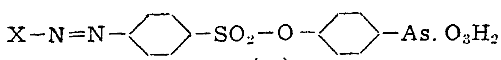
TABLE I

*Melting points of the synthesised compounds of the general formula*


(I)

| | $R_1$ | $R_2$ | M.P. °C |
|---|---|---|---|
| 1 | $C_6H_5$ | H | 170–72 |
| 2 | ,, | $NH_2$ | 195–97 |
| 3 | ,, | NHAC | 190–93 |
| 4 | p–$CH_3$–$C_6H_4$ | H | 205–7 (d) |
| 5 | ,, | NHAc | 203–5 (d) |
| 6 | ,, | $NH_2$ | 180–90 (d) |
| 7 | p–Cl–$C_6H_4$ | H | above 250 |
| 8 | ,, | $NO_2$ | 255–57 (d) |
| 9 | ,, | NHAc | 180–85 |
| 10 | ,, | $NH_2$, HCl | 242–43 (d) |
| 11 | p–NHAc$C_6H_4$ | H | Not sharp |
| 12 | ,, | $NO_2$ | 188–89 (d) |
| 13 | p–$NH_2C_6H_4$ | H | 179–81 |
| 14 | ,, | $NO_2$, HCl | 267–69 (d) |
| 15 | p–$C_{10}H_7$ | H | 278–80 (d) |
| 16 | ,, | $NO_2$ | 258–59 (d) with previous shrinking |
| 17 | ,, | NHAc | 203–5 (d) |
| 18 | ,, | $NH_2HCl$ | 139–40 (d) |

With a view to studying the pharmacological properties, a few arsenical azo dyes, of type (II), have been prepared from p-aminobenzene sulphonyl-oxy-phenyl arsonic acid (13).


(II)

X = hydroxy or amino-aryl residue.

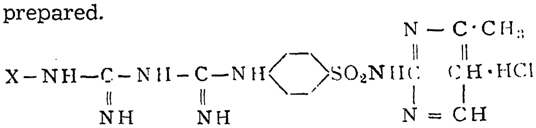
Full details will be published elsewhere.

Organic Chemistry Labs.,
Indian Institute of Science,
Bangalore,
A. C. ROY.
B. H. IYER.
P. C. GUHA.
*February* 20, 1948.

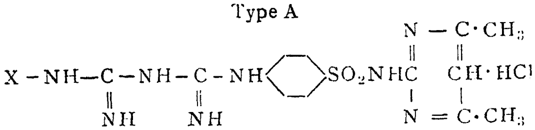
1. Krishnan, P. P., Iyer, B. H., and Guha, P. C, *Indian Chem. Soc.*, 1947, **24**, 285, 289, 565. 2. Benda, L., and Bertheim, A., *Ber.*, 1911, **44**, 3447. 3. Fox, H. H., *J. Org. Chem.*, 1947, **12**, 872.

## STUDIES IN ANTIMALARIALS SULPHABIGUANIDE DERIVATIVES

As a part of the systematic investigations[1,2,3] on substituted biguanides as possible antimalarials, we have previously reported[2] one compound each of type A and type B (where X = p-chlorophenyl). Sixteen more compounds (eight each of the type A and B, *vide* table) having different aryl substituents at $N^1$-position of the biguanide residue have now been prepared.



Type A



Type B

X = Substituted aryls.

TABLE

*Some sulphabiguanide derivatives*

| | X | Type A, M.P. °C. | Type B, M.P. °C. |
|---|---|---|---|
| 1 | Phenyl .. | 194 | 222 |
| 2 | *p*-Chlorophenyl[2] .. | 238 | 225 |
| 3 | 2 : 4-Dichlorophenyl | 220 | 223 |
| 4 | *p*-Bromophenyl .. | 231 | 232 |
| 5 | *p*-Iodophenyl .. | 227 (slight decomp.) | 232 (slight decomp.) |
| 6 | *p*-Methylphenyl .. | 231 | 238 |
| 7 | 3 : 4-Dimethylphenyl | 220 | 219 |
| 8 | *p*-Methoxyphenyl .. | 200 | 231 |
| 9 | *p*-Nitrophenyl | 230 (slight decomp.) | 257 |

The hydrochlorides of the sulphabiguanide derivatives of types A and B have been obtained by refluxing the appropriate arylcyanoguanidine with sulphamerazine hydrochloride and sulphamethazine hydrochloride respectively in 90 per cent. ethanol for 6-8 hours. All these compounds are white amorphous powders.

Considering that the formation of metallic complexes (chelates) by the biguanide structure of paludrine may be a possible mode of its action,[4] it was thought of interest to see the chelating capacity of these type of compounds. In an attempt to prepare copper chelates by Andreasch's method[5] it was observed that the sulphabiguanides, reported previously[2] as well as in the present note, show a very feeble tendency towards chelation, which is perhaps due to the electro-negative nature of the substituents. A feeble tendency towards chelation need not necessarily mean reduced antimalarial activity because it has been observed that some of the sulphabiguanides reported earlier,[2] although now shown to possess very little tendency for chelation, exhibited anti-malarial activity. Possibly their antimalarial activity does not depend so much upon their capacity for chelation as on the nature of the substituents at the two ends of the biguanide molecues.

Details of this work will be published elsewhere.

We wish to thank the Indian Research Fund Association for the award of a Fellowship to one of us (H. L. Bami).

Organic Chemistry Labs., Indian Institute of Science, Bangalore,
H. L. Bami.
B. H. Iyer.
P. C. Guha.
*March* 4, 1948.

1. Bami, H. L., Iyer, B. H., Guha, P. C., *J. Indian Inst. Sci.*, 1947, **29A**, 15. cf. *Curr. Sci.* 1947, **16**, 252. 2. *Indem.*, *Curr. Sci.*, 1947, **16**, 386. 3. *Indem.*, "Some $N^1$-aryl-$N^5$-metachloridine-biguanides" (unpublished work). 4. Curd, F. H. S., Rose, F. L., *Nature*, 1946, **158**, 707. 5. Andreasch, R., *Monatsh.*, 1927, **48**, 147.

## INFLUENCE OF GRADED DOSES OF NITROGEN ON THE QUALITY OF CANE JUICE AND JAGGERY RECOVERY

Studies on the optimum nitrogen requirement of sugarcane in respect of juice quality and jaggery recovery are recorded in this note.

Experiments during 1944-47 envisaged the application of organic nitrogen in the form of groundnut-cake in six equally spaced doses of 50 lbs. of nitrogen in the range of 0 to 250 lbs. per acre independently and in combination with 10 tons of farm-yard manure, applied as a basal dressing. The nitrogen was applied for each treatment in two equal parts, one at the time of planting (March) and the remainder at the time of trenching and earthing up (June). The layout of the experiment was one of a split plot design, where farm-yard manure and no farm-yard manure constituted the major treatments and six doses of nitrogen, the minor treatments.

A periodical analysis of cane-juice relating to each treatment was made from January to March in all the 3 years. The percentage jaggery recovery was studied by trial boilings of the cane juice. Results of these trials showed that:

(*i*) A progressive decrease in brix, sucrose and purity, and an increase in the glucose occur with an increasing dose of nitrogen.

(*ii*) A decrease in the quality of the juice with an increased dose of nitrogen occurs as reflected by the jaggery recovery, which showed a similar fall as the dose of nitrogen increased.

(*iii*) The effect of farm-yard manure (applied as a basal dressing) on juice quality was not consistent. In a majority of cases the series without farm-yard manure registered more sucrose and purity than that with the farm-yard manure.

(*iv*) The juice from all treatments attained higher percentages of sucrose and purity and also in jaggery recovery during the year 1944-45 than those in 1945-46. This may be attributed to the reason that the crop was grown in wet lands in the first year and on garden lands in the second year, and this behaviour is in line with the experience recorded on this research station. This also explains why the influence of higher

doses of nitrogen on juice quality and jaggery recovery is less marked in 1945-46.

Studies at this station show that 100 lbs. of nitrogen, as groundnut-cake, is the optimum from the point of both yield and cost of production per unit weight of cane and jaggery. A detailed communication on the subject, embracing all aspects of germination, growth, juice quality, yield of cane and jaggery and economics of manuring will separately be published.

Sugarcane Research Station,
Anakapalli, M. LAKSHMIKANTAM.
December 25, 1947. A. SANKARAM.

## THE PERSISTENCE OF YOLK-SAC IN BABY CHICKS DUE TO ESTROGEN TREATMENT

IN the chick the yolk-sac slips into the body cavity on the 10th day of embryonic life by a complex process. It is eventually absorbed with great rapidity and, as a result, the weight of the yolk-sac which is 5·34 gm. at the 12th hour after hatching is reduced to 0·05 gm. on the 6th day of post-hatching life.[1] Byerly[2] observed that the yolk-sac grows steadily from the first day of its formation to reach a maximum weight of about 3·5 gm. on the 15th day of incubation, after which the weight falls to approximately 2·5 gm. at hatching.

In course of an experiment on the responses of the oviduct of sexually immature female chicks to diethylstilbestrol[3] it was observed that in some hormone-treated baby chicks the yolk-sac was persistent. In uninjected controls, however, the yolk-sac was absent. The relevant data is presented in Table I:

TABLE I

*The weight of the persistent yolk-sac in baby chicks*

| Dosage | No. of birds | Age (days) | | Average weight of the yolk-sac (gm.) |
|---|---|---|---|---|
| Mgm. | | Initial | Autopsy | |
| Uninjected .. | 3 | 1 | 11 | No yolk-sac |
| 1 daily .. | 3 | 1 | 11 | 1·3 |
| 2 daily .. | 3 | 1 | 11 | 2·1 |
| Uninjected .. | 2 | 5 | 15 | No yolk-sac |
| 1·5 daily .. | 2 | 5 | 15 | 1·0 |
| 2 daily .. | 3 | 5 | 15 | 2·5 |
| Uninjected .. | 3 | 10 | 31 | No yolk-sac |
| 1·2 daily .. | 3 | 10 | 31 | 2·1 |
| 2 daily .. | 3 | 10 | 31 | 3·1 |

The table indicates that the level of hormone was a more important factor in determining the state of persistence of the yolk-sac rather than the age of the chicks or the duration of treatment. Thus in a particular age-group the chicks treated with higher dosage of estrogen exhibited heavier yolk-sac than those injected with lower dosage.

It is well known that in estrogen therapy undesirable gastro-intestinal reactions follow the use of diethylstilbestrol in large doses[4]. Possibly, in the present study, the dosage of this estrogen used proved to be too high for the baby chicks which exerted a harmful influence over the gastro-intestinal tract. Since the yolk-sac is intimately connected to the intestine it is not unlikely that this harmful influence was also extended over the yolk-sac and, as a result, the rate of absorption of yolk was considerably slowed down.

The present investigation was carried out at the Institute of Animal Genetics, University of Edinburgh, Scotland.

Thanks are due to Dr. J. G. Carr for valuable help.

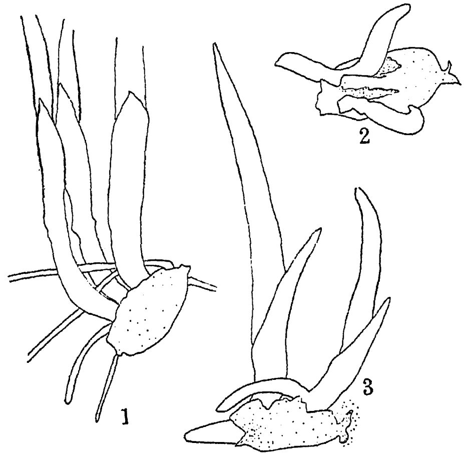
Department of Zoology, AMIYA B. KAR.
University of Calcutta,
and Department of Biology,
St. Xavier's College, Calcutta,
February 17, 1948.

1. Lillie, F. R., *The Development of the Chick*, New York, 1927. 2. Byerly, T. C., *J. Exp. Biol.*, 1932, **9,** 15. 3. Kar, A. B., *Poultry Science*, 1947, **26,** 352. 4. Grollman, A., *Essentials of Endocrinology*, Philadelphia, 1942.

## POLYEMBRYONY IN *DICHANTHIUM ANNULATUM* STAPF.

POLYEMBRYONY as observed by the writer in *Dichanthium annulatum* while studying the autecology of the common grass is reported in the following note.

About 1,500 seeds were germinated under different cultural operations and, out of these




one triplet and about a dozen twins emerged. The triplet came out of a seed treated with concentrated sulphuric acid preceding germination under water (Fig. 1). The twins, however, were observed in seeds germinating in sand and $KNO_3$ culture solution. Figs. 2 and 3 show the successive stages of development of the twins from $KNO_3$ solution.

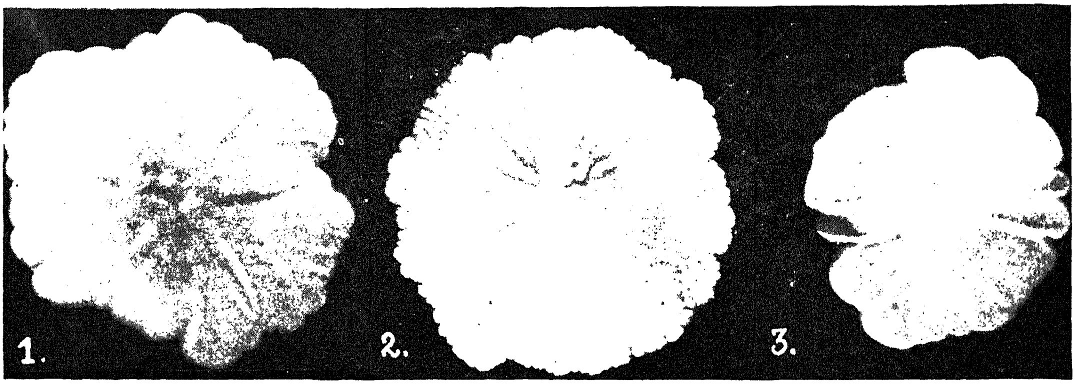
A complete account of the germination capacity of the seeds and the cytogenetic study of the polyembryonic cases in *D. annulatum* will be published later.

Department of Botany,
Benares Hindu University, K. C. MISRA.
January 12, 1948.

## A REVERSE MUTATION IN YEAST INDUCED BY ULTRAVIOLET IRRADIATION

INDISPUTABLE evidence for the identification of simple gene mutations in yeasts is not available in published literature.[1,2,3] The demonstration of tetraploidy[4] and chromosomal translocations[5,6] rendered necessary a clear distinction between chromosomal and gene mutations in yeasts. Definite identification of gene mutations would be possible only if reverse mutations could be demonstrated.[7]

As in bacteria, dissociative changes have been recorded in yeasts also.[8,9] It has recently been suggested[10] that mutations in bacteria are spontaneous, discontinuous and uninfluenced by the environment, that the establishment of these mutants and hence the changes in the characteristics of the cultures are determined by their growth-rate and viability and that the environment has a selective influence in that it controls the growth-rate as well as viability. Are the so-called dissociative changes in yeasts the result of gene mutations?



During the past 18 months a continuous but overlapping series of giant colonies of our two chromosome[11] control strain of brewery yeast, BY 1, have been under close observation. Photo 1 shows the appearance of the first colony of the control in September 1946. It had a wavy margin and radial folds on its surface. There was a sudden change in the characteristics of the colony in the month of April 1947. Its appearance is illustrated in Photo 2. The central region of the colony was smooth with sparse minute granulations and the outer half had a rough texture owing to the presence of minute powdery granulations on a lace-like sculpturing. The change was sudden and the smooth type entirely disappeared from the cultures. No colony was obtained in March-April showing both the types as sectors. As cytological investigations indicated no change in the chromosome constitution[12] it was assumed that the change was due to a gene mutation. Since the strain was kept in an active vegetative condition at room temperature, it was believed that the rough type had particular selection value at the summer temperatures as to eliminate the smooth type altogether from the cultures.

An attempt was, therefore, made to obtain a reverse mutation by exposure to ultra-violet irradiation. Transparent silica tubes containing actively multiplying cells were exposed to a mercury arc for 4 hours at a distance of 90 cms. Twenty-four hours after exposure, the material was plated and nine colonies were picked out from the plates. One of these, BYU 1, gave a smooth giant colony (Photo 3) resembling the first colony of the control.

Curiously enough, a spontaneous reversion of the rough to the smooth type was also observed in the months of September-October 1947, confirming the belief that the nature of sculpturing of the colony is determined by the alleles at a particular locus.

M. K. SUBRAMANIAM.
S. N. KRISHNA MURTHY.
Dept. of General Chemistry,
Indian Institute of Science,
Bangalore 3,
*March* 3, 1948.

1. Winge, O., and Laustsen, O., *Compt-rend. d. Lab. Carlsberg.*, 1939, **22**, (22), 357-74. 2. Winge O., *Ibid.*, 1944, **24**, (8), 79-96. 3. Skovsted, A., *Ibid.*, 1943, **23**, (2), 409-56. 4. Subramaniam, M. K., *Proc. Nat. Inst. Sci.* (*India*), 1947, **13**, (3), 129-39. 5. Subramaniam, M. K. and Ranganathan, B., *Nature*, 1946, **157**, 49. 6. Prema Bai, M., *Curr. Sci.*, 1947, **16**, 316-17. 7. Muller, H. J., *Biol. Revs.*, 1939, **14**, 261-89. 8. Punkari, L., and Henrici, A. T., *J. Bact.*, 1933, **26**, 125-38. 9. Fabian, F. B., and McCullough, N. B., *Ibid.*, 1934, **27**, 583-24. 10. Braun, W., *Bact. Revs.*, 1947, **11**, (2), 75-114. 11. Subramaniam, M. K., *Proc. Nat. Inst. Sci.* (*India*), 1946, **12**, 143-49. 12. —, *Curr. Sci.*, 1947, **16**, 157-58.

## CORRECT NAME OF *PLECTRANTHUS FRUTICOSUS* (BENTH) HOOK. f.

HOOKER, F.,[1] described a species of *Labiatæ* under the above name based on *Coleus fruticosus* Benth.,[2] from the Palni Hills of South India. This plant was collected from the vicinity of Kodaikanal Lake by Bourne and is mentioned by Fischer[3] and Gamble.[4] Recently Fyson[5] also recorded the plant under this name, and in his revision of Indian Labiatæ, Muker-

jee[6] has also kept up the name. Unfortunately, however, this name, being a later homonym is invalid according to rules.[7] It is pre-occupied by a distinct and different plant from South Africa—*Plectranthus fruticosus* L'Herit.[8] I have been able to trace the correct name for the South Indian plant which is *Plectranthus deccanicus* Briq.,[9] and this name should be used to designate all the Indian herbaria sheets hitherto known as *Plectranthus fruticosus* (Benth.) Hook.f. *non* L'Herit. It appears that Briquet's new name, being published in a journal of comparatively less prominence has escaped the notice of botanists referred to above.

Bentham's reference[2] to *Wight Catalogue*, No. 2514, was misquoted by Hooker[1] as 2524. Neither of these numbers nor the name *Coleus fruticosus* could be found in Wight's Catalogue. Therefore, Wight's name should not be cited in connection with this plant.

Hooker's *Plectranthus urticifolius* (*l.c.* 6222) also requires a new name being pre-occupied by *Plectranthus urticifolius* (Lam.) Salisb.[10]; but as Mrs. M. Lewis is at present engaged in a revision of the genus (at Kew), I refrain from proposing a new name for this plant.

The Herbarium,
Royal Botanic Gardens,
Kew, Surrey, D. CHATTERJEE.
*February* 11, 1948.

1. *Fl. Br. Ind.*, 1885, **4**, 623. 2. *Dc Prodr.*, 1848, **12**, 78. 3. *Rec. Bot. Surv. India.*, 1921, **9**, 143. 4. *Fl. Madras* 1924, 1122. 5. *Fl. South India, Hill, St.*, 1932, **1**, 467. 6. *Rec. Bot Surv India*, 1940. **14**, 48. 7. Art. **61**, *International Rules of Botanical Nomenclature*, **19**, 1935. 8 *Stirp.* Nov. 1, 85 *et tab.* 41 (March, 1788) The date of issue of this fascicle was March, 1788, although on the title page the year 1785 occurs *see J. Bot.* 1905, **43**, 268. 9. *Ann. Conserv. and Jard. Bot. Geneve*, 1898, **2**, 234. 10. *Prodr. Stirp. Hort. Chapel Allerton Vig.*, 88, 1796.

## ON THE HABITS OF THE EXOTIC MOSQUITO-FISH *GAMBUSIA AFFINIS* (BAIRD AND GIRARD) IN THE WATERS OF MADRAS

THE introduction and acclimatisation of *Gambusia affinis* in North India have been described by Mulligan and Majid.[1] In Madras, the species was introduced on two occasions. Firstly, in 1929 a consignment of 600 was imported from Ceylon by the Fisheries Department for stocking two nurseries attached to the Krusadai Biological Station. Secondly, a consignment of 100 was brought to Madras City from Bangalore in 1930 through the efforts of the Malaria Officer. Since then *Gambusia* has attained a local stand in the Province, and now occurs in many brackish water canals and creeks and in freshwaters from the coastal area up to an elevation of about 7,000 feet.

The following are the observations made from the provincial waters of Madras, showing variations from those of Kuntz,[2] Hildebrand[3] and Seale[4] on the bionomics of *Gambusia* from the waters of the Americas and the Philippines.

*Maximum size*: 5·2 cms. in males and 6·8 cms. in females.

*Proportion of males and fema* : Equal.

*Food*: (1) *Insecta*, such as Diptera larvæ, Hemiptera adults and larvæ and Coleoptera adults and larvæ: 45 per cent.; (2) *Crustacea*.—Copepods, Daphnids and Cypris: 15 per cent.; (3) Desmids and diatoms.—*Closterium, Cosmarium, Eunotia, Fragilaria, Melosira, Navicula, Pinnularia, Staurastrum, Synedra* and *Tabellaria*: 25 per cent; and (4) Algal filaments of *Cladophora, Œdogonium, Oscillatoria*, and *Spyrogyra*: 15 per cent.

*Maturity*: Attained when 3 months old and about 3 cms. in size.

*Breeding Season*: Throughout the year with a maximal from October to November.

*Eggs*: 120, 1·8 mm. in diameter, in each ovary.

*Parturition*: 23 to 35 larvæ liberated within 20 to 30 minutes. Post-natal recuperation of mother is by feeding on 5 to 8 young ones.

*Description of Larva*: 8 mm. in size. Transparent body with black eyes.

*Post-larval development*: Yolk-sac absorbed on sixth day. Pigmentation completed on 15th day. Adult characters assumed within eight weeks.

*Communal Association*: Its voracious habit has caused a striking diminution in the population of the indigenous form, *Aplocheilus blochii* (Jerdon).

*Larvicidal propensity*: Female consumes 260 mosquito larvæ in a day, whereas the male takes in only about 60; hardy fish adapting to all types of lentic environments. Russel and Jacob[5] and Bhasker and Ramoo[6] have found the species useful for mosquito control even in shallow casurina pits and wells. Those longer than 30 mm. stand transport well.

Inland Fisheries Office,
8, Ormes Road, P. I. CHACKO.
Kilpauk, Madras,
*February* 3, 1948.

* Communicated with the kind permission of the Director of Industries and Commerce, Madras.

1. Mulligan, H. W., and Majid, S. A., *Rec. Mal. Sur. India.*, 1936, **6**, 537. 2. Kuntz, A., *Bull U.S Bur. Fish.*, 1915, **33**, 177-90. 3. Hildebrand, S F., *Rep. U.S. Comm Fish.*, 1917, App. **6**, 1. 4. Seale, A., *Phil. J. Sci.* 1917, **12**, 177. 5 Russel P. F., and Jacob, V. P. *J Mal. Inst India.*, 1939, **2**, (3), 273-91. 6. Bhasker, R. R., and Ramoo, H., *J. Mal. Inst. India.*, 1942 **4**, 633

## ROLE OF PROTOZOA IN THE CONCENTRATION OF NITROGEN IN THE SLUDGE DURING AEROBIC PURIFICATION OF SEWAGE

THE importance of micro-organisms in the nitrogen cycle has long been recognised and considerable amount of attention has been devoted to the study of nitrogen conservation in soil and sewage.[1] Certain forms of protozoa, such as the species of *Hartmanella, Heteromita, Colponema, Colpoda, Colpidium*, and *Oxytricha*, have been found to stimulate bacterial fixation

of nitrogen.[2-4] It has also been suggested that a large part of the nitrogen found in activated sludge is traceable to its protozoan content,[5] though it has been contended that the increased nitrogen content of activated sludge due to the growth of protozoa is not necessarily very high.[6]

Further to our earlier observations on the special significance of *Vorticellids* in the aerobic purification of sewage and sludge formation,[7,8] we have carried out studies on the role of *Epistylis* sp. and *Vorticella* sp. in the concentration of nitrogen in the sludges.

Homogeneous fæcal suspensions were treated as follows: (*i*) aerated as such (*ii*) inoculated with an active culture (16 ml.) of *Epistylis* sp. and then aerated; and (*iii*) inoculated with an inactive culture (16 ml. after heating to 60° C.) of *Epistylis* sp. and then aerated. The aerations were carried out for 120 hours and the sludges separating from representative samples analysed for their nitrogen contents. The results are given in Table I.

In another set of experiments, heat-sterilised suspensions of sewage, soil and compost were aerated with *Vorticella* sp. and 79 different strains of bacteria (characterised according to Bergey[9]) isolated from samples of water, sewage, soil, compost and fæces of animals. The influence of individual strains of bacteria from different sources on nitrogen concentration by *Vorticella* sp. in the sludges as obtained after aeration of the media for 96 hours was studied (Table II).

TABLE I

*Concentration of nitrogen in sludge as effected by protozoa*

| Medium | Total N (mg.) in fæcal suspension (800 c.c.) | N (mg.) added to suspension as protozoa (alive or dead) | After 24 hours' aeration: N (mg.) in sludge after deducting the N added as inoculum | After 24 hours' aeration: % of fæcal N concentrated in sludge | After 120 hours' aeration: N (mg.) in sludge after deducting the N added as inoculum | After 120 hours' aeration: % of fæcal N concentrated in sludge |
|---|---|---|---|---|---|---|
| Fæcal suspension alone | 24·64 | .. | 1·2 | 4·9 | 6·3 | 25·6 |
| Fæcal suspension + *Epistylis* sp. (active) | 24·64 | 10·6 | 15·9 | 64·5 | 12·3 | 49·9 |
| Fæcal suspension + *Epistylis* sp. (dead) | 24·64 | 10·6 | 4·2 | 17·0 | 6·0 | 24·4 |

TABLE II

*Influence of different bacteria on nitrogen concentration by protozoa in sludges*

| Sources of bacteria | No. of bacterial strains isolated | Medium for sludge formation | No. of strains without effect on nitrogen concentration by *Vorticella* sp. | No. of strains affecting nitrogen concentration by *Vorticella* sp.: No. of strains | % increase of N in sludge | No. of strains | % decrease of N in sludge |
|---|---|---|---|---|---|---|---|
| Water samples from bore-wells, tanks and river | 11 | Sterilised sewage | Nil | 4 | 0·53–2·01 | 7 | 0·96–15·77 |
| Garden soil .. | 6 | Sterilised soil suspension | Nil | Nil | .. | 6 | 0·29–17·00 |
| Compost heaps .. | 13 | Sterilised compost extract | 3 | 3 | 0·47–2·84 | 7 | 0·49–12·93 |
| Raw sewage .. | 2 | Sterilised sewage | Nil | 1 | 0·49 | 1 | 2·07 |
| Septic tank sludge .. | 2 | ,, | 2 | Nil | .. | Nil | .. |
| Activated sludge .. | 3 | ,, | Nil | Nil | .. | 3 | 0·64–0·75 |
| Cow dung .. | 7 | ,, | Nil | 2 | 0·04–0·60 | 5 | 0·26–1·76 |
| Horse dung .. | 8 | ,, | Nil | 4 | 0·55–1·70 | 4 | 2·83–11·04 |
| Fæces of other animals (rat, rabbit, dog and monkey) | 27 | ,, | 3 | 13 | 0·26–3·61 | 11 | 0·17–9·93 |

1 c.c. of active bacterial culture was used as inoculum in each case; the protozoan inoculum contained about 20,000 active cells of *Vorticella* sp.

It may be seen from Table I that there is rapid concentration of nitrogen in the sludge when the *Epistylis* sp. is introduced. This nitrogen is, however, partly lost when the aeration is continued for 120 hours. In presence of dead protozoa the concentration of nitrogen at the end of 24 hours is more pronounced than when fæcal suspension alone is aerated. The effect may be due to either some mechanical action of the dead cells or some associated substance, active even after destruction of protozoa.

As will be seen from Table II, very few of the isolated bacteria augment the action of protozoa. On the other hand, some of the bacteria seem to be fairly efficient in reducing the nitrogen content of the sludge.

The trend of evidence would suggest that

while the protozoa are efficient in concentrating the nitrogen in the sludge in the early stages, many of the associated bacteria produce a reverse effect when the aeration is prolonged. A small part of the nitrogen gets nitrified and passes into the effluent. The major part would still remain to be accounted for. The extent to which the latter passes into the effluent or is lost from the medium requires further study.

In actual practice, the total period of aeration in the Activated Sludge tank would be only a few hours. Raw sewage keeps on entering at one end, while the effluent continuously passes out at the other end. Under these conditions, there would be no scope for any secondary bacterial action leading to any loss of nitrogen from the sludge. If the aeration is prolonged, however, or during periods when little or no fresh sewage enters the tank, the secondary action may take place to some extent.

It is not clear whether any fixation of atmospheric nitrogen takes place through the direct or the indirect agency of either *Vorticella* sp. or *Epistylis* sp. This aspect would require careful study in view of the earlier observations[10–14] in regard to the fixation of atmospheric nitrogen in Activated Sludge. This important aspect is now under study and will be the subject of a later communication.

Dept. of Biochemistry, S. C. Pillai.
Indian Institute of Science, T. K. Wadhwani.
Bangalore, M. L. Gurbaxani.
*February* 21, 1948. V. Subrahmanyan.

---

Fowler, G. J., "An introduction to the biochemistry of nitrogen conservation," 1934, Edward Arnold & Co. 2. Nasir, S. M., *Ann. Appl. Biol.*, 1923, **10**, 122. 3. Cutler, D. W. and Bal, D. V., *Ibid.*, 1926, **13**, 516. 4. Hervey, R. J. and Greves, J. E., *Soil Sci.*, 1941, **51**, 85. 5. Richards, E. H. and Sawyer, G. C., *J. Soc. Chem. Ind.*, 1922, **41**, 62T. 6. Ardern, E., Jepson, C. and Gaunt, P., *J. Soc. Chem. Ind.*, 1923, **42**, 230T. 7. Pillai, S. C., *Current Sci.*, 1941, **10**, 85; *Ibid.*, 1942, **11**, 437. 8. Pillai, S. C., and Subrahmanyan, V., *Nature*, 1942, **150**, 525; *Ibid.*, 1944, **154**, 179. 9. Bergey, D. H., *et al.*, "Manual of determinative bacteriology", 1939, Baltimore. 10. Fowler, G. J., *J. Ind. Inst. Sci.*, 1920–21, **3**, 227. 11. Peck, C. L., *Eng. News-Record*, 1923, **90**, 487. 12. Buswell, A. M., *Ibid.* 1923, **90**, 843. 13. Mohlman, F. W. and Pearse, L., *Ibid.*, 1923, **90**, 844. 14. Beard, P. J. and Munson, L., *Sewage Works, J.*, 1932, **4**, 1002.

---

## INDIAN RESEARCH COUNCIL

The Governing Body of the Council of Industrial and Scientific Research met at Delhi in the first week of February 1948 to consider a number of schemes and projects of research and industry.

A Committee was set up to work out the details of a scheme for the manufacture of synthetic petrol from low-grade coal. The Council decided that intensified geological and geophysical exploration of possible areas of occurrence of petroleum in India should be carried out by the Government. It was also recommended to the Government that the possibility of buying crude petroleum from the Iranian and Burma oil-fields and refining it at two or three refineries at Indian ports should be explored.

On the recommendation of the Fuel Research Committee the establishment of three field survey stations for research in coal in the C.P., Raniganj and Bokhro-Raigarh coal-fields at a cost of Rs. 9 lakhs was approved. It was also recommended to the Government that a statutory cess of half anna per ton of coal despatched in India should be levied for aiding fuel research in the country.

It was also decided to have detailed plans for carrying underground gassification of coal which has brought about revolutionary changes in fuel technology in the world, particularly in Russia and the U.S.A.

To promote the development of dyestuffs both the educational and on the industrial research sides, the Council agreed to provide additional funds to the Bombay University for the creation of a professorship in Dyestuff Technology and for the institution of six research fellowships. The Council has been granting for some time to the Bombay University an annual recurring grant of Rs. 25,000 for the Department of Dyestuff Technology which will now be increased to Rs. 54,000. Fifty per cent. of the seats in the department will be reserved for students belonging to Provinces other than Bombay.

Two important schemes in the field of atomic research, *viz.*, theoretical studies in the properties of Meson Field and biological aspects of atomic research, were sanctioned at a cost of Rs. 50,000. The latter scheme will be investigated at the Tata Memorial Hospital in Bombay.

Revised plans of the Central Institute of Drug Research, the establishment of which was approved last year, were accepted by the Council at its meeting. The Institute will be established at a capital cost of Rs. 20 lakhs and will cover a very vide scope of activity.

The Indian Chemical Manufacturers' Association have also agreed to finance the Institute to a considerable extent. A Special Committee with Dr. Jivraj Mehta as Chairman has been set up to select a suitable place for the location of Institute.

# REVIEWS

**Alternating Current Electrical Engineering.** By Philip Kemp. (Macmillan & Co., Ltd., London), 1947. Seventh Edition. Pp. ix + 659, with 450 figures. Price 25*sh.* net.

The applications of electricity to human needs and comfort are so great and growing that it has become indispensable to the daily life of the community and of the individual. It is difficult to imagine to-day a world without electricity. Inevitably, electrical engineering, specially alternating current electrical engineering, continues to develop unceasingly in every direction. No text-book even of the size of the one under review can, therefore, deal with more than the essential principles of carefully selected aspects of the subject. This is what Prof. Kemp seeks to do in this book on alternating current electrical engineering, and he is an author and teacher of long standing well known in his field. Of the quality of the book and its popularity, it is enough to note that since it was first published in 1918, it has run through seven editions and been reprinted twice.

This is not a specialist's book nor is it addressed to the designer of alternating current machinery and equipment. It is meant for the student of electrical engineering preparing for his bachelor's degree or its equivalent, and for the "engineers whose student-days are over" and who may wish to "use it to refresh their memories when called upon to solve problems which are out of their normal course of work".

An adequate grasp of the general theory of alternating currents is an indispensable requisite to a study of this branch of electrical engineering; it is, therefore, satisfactory that a quarter of the book is devoted to a discussion of it in the first thirteen chapters; the ground covered includes the vectorial and the symbolic methods of representing alternating quantities, inductance and capacity as circuit elements, resonance, power and power factor, polyphase currents and rotating fields. In addition, there are chapters on Transients and Oscillatory Circuits at the end of the book; but a more suitable place for these would be after Chapter VIII.

These provide the basis for the succeeding chapters, 14 to 32, on the different types of alternating current machinery, starting with the transformer and ending with three-phase commutator motors and power factor control. The treatment is more detailed and comprehensive in the cases of the transformer, the alternator and the induction motor. There is a separate chapter on the principles of design in each of these three cases. The author takes care, and very rightly, to point out in the Preface that these chapters "do not constitute a design manual" and that design "can only be learned by experience in actual practice".

In revising the book for the present edition, the author has endeavoured to bring the book up-to-date not only in the treatment of the different aspects of the subject, but in including within its pages a number of important developments of recent years.. The selsyn principle, for example, which is being applied so increasingly during and since the war is explained under Induction Motors (p. 369). The chapter on Rectifiers includes a discussion of the phase and bias control of ignition and a brief mention of the copper oxide rectifier. Chapter 32 on the Three-Phase Commutator Motor mostly deals with the Schrage Motor along with a brief explanation of the No-Lag Motor. Lead oxide and Thyrite Arrestors are discussed under Protection of A.C. Systems.

The role of electronics and electron tubes in every branch of electrical engineering is so great and increasing so rapidly that no electrical engineer can now-a-days do without a study of it. It is a part of his professional equipment. It is, therefore, surprising that it should have been deliberately omitted from the scope of the book; the omission is all the more notable as the author has included subjects like the mercury arc rectifier, the cathode-ray oscillograph, oscillatory and coupled circuits and even the obsolete spark method of producing oscillatory currents. By including a brief exposition of electronics, the book would have gained in value without any serious increase in its size and cost.

The printing and the general get up of the book leave little to be wished for. But a special word of praise is due to the 450 figures that illustrate the text. At the end of each chapter there are a selected number of examples, the solutions for which are given towards the end of the book. The explanation is everywhere clear and concise and the mathematical treatment adequate and within reach of the student for whom the book is intended. No errors were noticed in the text. No references are given to original papers; this in many ways is an advantage to the beginner.

One or two matters, however, call for comment. On page 11, what the author means by Ohm's Law is not very clear; nor is the explanation on pages 58 and 59 on the current in a condenser. Why not follow Maxwell's explanation that a changing electric field constitutes an electric current the value of which is proportional to the rate of change of the field? This, every time is the simplest and the best explanation. On page 16, it is stated that the induced e.m.f. in an inductance opposes the applied e.m.f. producing the current. This surely is not right. The induced e.m.f. adds to or opposes the applied e.m.f. according as the current in the inductance is either decreasing or increasing. Another matter of some importance is the definition of the phase of an alternating quantity and the difference of phase between two such quantities. The book is certain to serve as a valuable guide to students of electrical engineering.

R. E.

**The Growth of Physical Science.** By Sir James Jeans. (Cambridge University Press), 1947. Pp. 364. Price 12*sh.* 6*d.*

The book under review is the last one written by Sir James Jeans before his death in September 1946. The late Sir James Jeans was known throughout the world for his lucid exposition of science in books intended for the general public. The present volume forms yet another example giving testimony to the author's wide range of interest and knowledge and also to his splendid gift of exposition.

The history of science is truly the story of the great originators. In keeping with this, the author traces the life-histories of the prominent men of science and their contributions to physics including mathematics and astronomy. The arrangement is such that we get a coherent account of the growth of modern physical science and the steps by which it has attained its present state and importance. The author has also given an account of the progress of mathematics which, as is well known, is intimately connected with the progress of physical science.

The book is divided into eight chapters, each one dealing with the growth of science during a specific period. Chapter I contains an account of the remote beginnings during the three millennia of Babylon and Egypt starting from the earliest evidence of the systematic interest in science coming from the civilisation which existed in the river basins of the Euphrates and the Nile in the new-stone age. The second chapter refers to the period covering the first three centuries (600-320 B.C.) of scientific progress in Greece which was almost entirely mathematical, forming a sort of intellectual golden age. The next chapter deals with science in Alexandria which became the intellectual centre of the world for many generations (322 B.C.-A.D. 642). Chapter IV deals with the causes for the stagnation of scientific progress during the next eight hundred years. Jeans has aptly described this period as the dark age as far as science was concerned. The spread of Christianity and Islam during this period was largely responsible for strangling the growth of science and bringing about ultimately the decline of Alexandria, the great city of learning. During this era, education and scientific knowledge were almost the exclusive prerogative of the church. The renaissance of the scientific spirit which followed the invention of the printing press in Europe is described in Chapter V. This period (1452-1600) started with the birth of Leonardo da Vinci who was the first to approach the study of nature in a truly modern spirit. With Leonardo science began to adopt modern aims and methods. The noteworthy advances made in astronomy, mechanics and mathematics respectively by Copernicus, Stevinus, Galileo and Fontanna in the sixteenth century are detailed in the same chapter. The progress of science in the seventeenth century (described as the "Century of Genius") is contained in Chapter VI. A detailed account is given of the many valuable contributions made to astronomy notably by Kepler, Galileo and Newton, to optics by Newton, Hooke, Huygens and Snell, to the knowledge of the structure of matter by Boyle, and to mathematics by Descartes, Fermat, Cavalieri and Leibnitz. Chapter VII refers to the period covering two centuries after Newton (1701-1897). This period, if not so strikingly brilliant as its great predecessor, was at least one of solid progress. It provided an abundance of first class investigators like Lagrange, Hamilton, Laplace, Bradley, Herschel, Young, Fresnel, Fizeau, Lavoisier, Dalton, Kelvin, Faraday and Maxwell, to mention only a few. Finally the era of modern physics which commenced with the famous Michelson-Morley experiment (1887) is dealt with in the last chapter. The tremendous progress made during the last sixty years has been beautifully summarised in about seventy pages.

Although detailed reference has been made in the book to the contributions made to the progress of physics and astronomy by numerous investigators in various countries of the world, one looks in vain for adequate reference either to ancient Hindu astronomy or to the important contributions of Indian scientists especially in the field of physics and astronomy in recent years. Except for this omission, the story of the growth of physical science starting with the Babylonian system of counting and ending with the recent ramifications into the mystery of the sub-atomic structure, is told in a fascinating manner in this volume. The book has been written in a simple and elegant style so as to interest even the layman. The book will be extremely informative not only to students of physics but also to the general reader who wishes to enrich himself with the knowledge of the growth, achievements and potentialities of physical science.

R. S. K.

**High Polymers, Vol. VII.—Phenoplasts.** By T. S. Carswell. (Interscience Publishers Inc., New York), 1947. Pp. 267. Price $5.50.

This handsome book on Phenoplasts, their structure, properties and technology, is a welcome addition to the library of the prastic chemist. The book deals with the recent developments in the study of phenoplasts. Subdivided into several sections with brief introductions for most of them the book gives a good account of the general reactions of phenols and aldehydes, the physical structure of the resins, the various types of fillers used in molding compositions, the mechanical, electrical and thermal properties of the phenoplasts. In the concluding sections are briefly given the technical manufacture, the molding technique and the miscellaneous technical applications of the phenoplasts, intended for the research chemist, as the author rightly points out in the preface to the book. Emphasis has been laid on the recent developments of the study of phenoplasts, and the book gives considerable data on present trends in the development of the phenoplastics.

The book is well indexed, nicely got up and deserves a place in any scientific library.

M. S. Muthanna.

**Annual Report of the Public Health Commissioner with the Government of India for 1945.** (Manager of Publications, New Delhi.) Pp. 84 + vi, with 2 maps and 5 charts. As. 14.

The detailed Annual Report of the health activities in British India which was temporarily suspended during the years 1941 to 1944 has been resumed from the year 1945. The year under review saw the termination of the global war first in the European and then in the Pacific theatre. The world was left with war-weary, under-nourished population on a scale not previously encountered. The pandemic of influenza of the type which swept countries after World War I was feared, and special watch was maintained at ports to check immediately any importation of influenza into the country. Another notable feature is the vigilance with which the air-port authorities at Karachi worked for effectively stemming the introduction of yellow fever into India as the aerial traffic to India, especially through North Africa was greatly increased owing to war conditions.

India continues to be the largest reservoir of the infections of smallpox, cholera and plague, the reason being the low level of the environmental sanitation and the absence of a controlled and protected water supply for the vast rural population and the chronic malnutrition aggravated by war conditions. Lack of medical and sanitary personnel with the civilian administration of the provinces and in some cases inadequate supply of drugs and disinfectants hampered control of infectious diseases. The control of epidemic diseases at fairs and festivals has improved considerably, and this measure has materially reduced the danger of spread of epidemics by pilgrims. The *Ardh Kumbh Mela* in the United Provinces had always been followed by a heavy incidence of cholera in the Punjab during April. It is gratifying that this year no case of cholera was reported. The death rate for British India decreased from 24·1 per million in 1944 to 21·5 in 1945. With the exception of Central Provinces and Orissa the death rates in 1945 were on the same level as in pre-war years. On the other hand, birth rate increased from 25·4 per million in 1944 to 27·3 per million although the pre-war birth rate of 34·5 per million has not been touched. There was no abnormal incidence of malaria anywhere except in Orissa, Central Provinces and in some parts of Madras. The usual activities for the distribution of quinine or its substitutes and the adoption of anti-larval and anti-adult mosquito measures were carried out throughout British India. Useful work continued to be done by the Department as regards anti-tuberculosis work. Inadequacy of institutional arrangements to deal with actual cases and their contacts remains the same as before.

The unique event in the history of Health Planning in India was the completion of the report of the Health Survey and Development Committee under the chairmanship of Sir Joseph Bhore. This Committee, in consultation with the distinguished workers in the field of health from the U.S.A., U.S.S.R., and Australia, has given a comprehensive survey of existing Indian conditions together with recommendations and plans which, if successfully put into operation, goes a long way in improving the health of the rural and urban population of India.

Medical Reesearch in India has shown considerable progress extending over a wide field —problems relating to the control of malaria, cholera, plague and leprosy. Nutrition Research has taken a prominent place, and a number of useful inquiries regarding the role of vitamins especially vitamins B, C and D, and proteins in health and disease were in progress. Experimental trials on Monkey malaria were carried out with Palludrine and the drug promises to be superior to Mapacrine. Welfare work by voluntary organisations such as the Indian Red Cross Society, Tuberculosis Association of India, British Empire Relief Association (Indian Council) and International Health Division of the Rockefeller Foundation in India and others have contributed a great deal towards the improvement of public health in the various provinces and Indian States.

There are two maps and several interesting and explanatory charts which enhance the value of the Report.

A. S. RAMASWAMY.

**Records and Research in Engineering and Industrial Science,** By J. Edwin Holmstrom. (Chapman & Hall, Ltd.), 1947. Pp. xii + 366. Price 21*sh*. net.

The progress of scientific and technical research in any subject cannot flourish in isolation; it must be collated at all times for the use and guidance of all scientific workers. To compile such information, to serve as a ready guide to all those interested, is a difficult task, and Dr. Holmstorm's book shows how to overcome these difficulties. The book can be broadly divided into three parts. In the first part the author emphasizes the importance of collation of fundamental research in relation to engineering industry, and of statistical examinations providing the key to questions of technical design so vital to the progress of the industry. That the pace of advancement in technical fields quickens through a properly divided team-work is clearly set out by the author who quotes appropriate examples. In the other part of the book he gives an outline of the British Collations and International Organisations for the promotion of Scientific Research and makes a passing reference to Indian National and other organisations. In the third part he deals with the recording and circulation of technical information, indexing, photographic reproduction, microphotography, translation of foreign languages and other allied subjects; the author also presents his own system of classifications. On the surface of it, organisation and administration of a technical library appears an easy affair. To provide a research worker exactly and expeditiously material he wants at the moment, is not very simple. This book shows in a very clear style librarianship in recording all the valuable information about research on technological subjects. It is hoped that every librarian will be greatly benefited by a study of this very useful book.

M. S. T.

**Surveying of Existing Information and Data on Radio Noise over the Frequency Range 1-30 Mc/s.** (Published by the Department of Scientific and Industrial Research.) RADIO Research Special Report, No. 15.

This report is probably the first of its kind to supply information on most of the available published literature dealing with all types of noise, whether of man-made, atmospheric or extraterrestrial origin encountered in radio reception, in the frequency range 1 to 30 mc/s. The present report has been prepared and presented in as cohrent a form as possible, before embarking upon a long-term research in order to supplement our existing knowledge of the nature, origin, prevalence, intensity of different types of noise that affect radio reception in the frequency range mentioned.

Noises that can spoil satisfactory reception have been classified as receiver, thermal, cosmic, atmospheric and man-made. It has been shown how a thorough theroetical and practical consideration lead to a proper assessment of noise levels at various locations.

The report, consisting mainly of nine sections, deals with receiver noise both internal and external, and thermal noise in sections 2 and 3 respectively.

The fourth section discusses noise due to cosmic radiation. This has the characteristics of fluctuation noise and affects the reception within 15 to 30 mc/s. It is recommended in this connection that further experimental information should be collected from all parts of the world with more refined equipment in order to assist in the eventual development of a satisfactory explanation which will prove to be a valuable contribution to the domain of both radio communication and astrophysics. The fifth section deals with atmospheric noise which produces clicks, crackles or crashes in radio reception. Information regarding the diurnal, seasonal and annual variation of noise level at various locations are recorded. Consideration is given to the theories of charge separation and initiation of discharge and also the manner in which the intensity is affected by effects of earth curvature, sky-wave reflections, etc.

Section six deals with various types of man-made noise. It is suggested that, with suitable precautions at the source and the receiver end, the effect of this interference can be made inappreciable.

Section seven discusses amplitude and frequency characteristics of both fluctuation and impulsive noise. Section eight describes various methods of noise measurement and suggest that the existing methods need much improvement before any satisfactory conclusions can be arrived at from such measurements.

The report ends with certain valuable recommendations in Section nine for increasing our existing knowledge. Many new problems have been suggested so that the report is valuable not only as scientific information but also as guide to the workers in this field.

S. K. C.

**Nutrition in Relation to Cancer.** *Annals of the New York Academy of Sciences*, Vol. XLIX, Article 1, pages 1-140. (Published by the Academy), September 1947.

It is generally believed that in spite of a large number of persons working on cancer, no really worth-while discoveries have been made relating to either the causation or the treatment of malignant disease. This belief is only partly true, because cancer research is dependent on our knowledge of fundamental life processes in tissues and their cells, and our ignorance of these processes is still abysmal. However there is an effort from several directions for arriving at a clearer understanding of the biological phenomenon of growth and also of abnormal growth of cancer. A good deal of very valuable knowledge has accumulated as a result of the patient study by "meticulous plodders", medical men, biochemists, physicists and biologists and it appears that gradually this knowledge is taking shape like pieces of a jigsaw puzzle.

One of the recent observations relates to the important role which nutrition plays in development of tumours in mice and men. The New York Academy of Sciences is, therefore, to be congratulated in bringing together men working on different aspects of the problem of *Nutrition in Relation to Cancer* and publishing a resumé of their observations in the form of a booklet. It is a compilation of papers read by recognised workers in the field of cancer research in U.S.A. at a conference organised by the New York Academy of Sciences and Panel on Nutrition, Committee on Growth, National Research Council in December, 1946. The papers deal with the researches carried out on the effects of varying caloric intake upon tumours, the mechanism of effects of increased intake of fats, carbohydrates and other dietary factors on carcinogenesis, the role of vitamin B complex, the milk-borne mammary-tumour producing agent in mice, etc. The workers in medical institutions will be particularly interested in a new orientation to the problem from a study of plants (Robbins), chemically induced mutations (Tatum) and nutrition of monocellular organisms (Kidder), which are fields of investigation usually outside their purview.

The paper on caloric intake is important, as data are presented which show that caloric restricted diet inhibits the production of several types of mouse tumours. Miller reviews a phase of studies by the Wisconsin group on the carcinogenic azo dyes and the remarkable effect that diet exerts in the production of liver tumours. His findings on the incidence of these tumours agree with those observed by workers in this country in the laboratories of the Tata Memorial Hospital. White and his associates have observed a reduction in the incidence of leukemia from 92·1 to 55 per cent. in a group of animals kept on cystine-restricted diet. It might have been better if the sex of the animals in the two groups had been mentioned. Tatum has dealt very ably with the mutation theory of cancer, which is attracting much attention at the present moment and has stated the present-day position as "many of the known facts regarding the changes taking place during carcinogenesis seem to support this theory, and

perhaps none are in actual disagreement". One of the important contributions is by the Alabama group (*Copeland et al.*) who have demonstrated the occurrence of neoplasms in 40 out of 69 rats with diets deficient in choline and related nutrients. The choline-deficient diet gave rise to neoplasms in lung, liver, pancreas, bladder in these animals. The number of animals is probably too small for the number of diets used and it is necessary to extend these remarkable findings. The work by Kensler on the demethylation of the dye, p-dimethyl aminoazobenzene, and his experiments on the inhibition of succinoxidase activity of rat liver slices is already well known, and has opened up a new field for future work.

The booklet is recommended for careful study by all persons interested in problems dealing with cancer or nutrition.

V. S. WARAVDEKAR.

**The Terpenes.** *Vol. I.—The Simpler Acyclic and Monocyclic Terpenes and Their Derivatives.* By J. L. Simonsen. Second Edition, revised and reset by J. L. Simonsen and L. N. Owen. (Cambridge University Press), 1947. Pp. 479. 30*sh.* net.

The first edition of this valuable contribution to the chemistry of terpenes was published in 1931. The plan and scope of this edition remains unaltered, but much new material has been added: Angustione, dehydroangustione, leptospermone, cryptone, piperitenone, isopiperitenone and greater information concerning a large number of other substances are included. The elucidation of the extremely difficult problem of preparing purified specimens of the isomeric menthones, menthols, etc., has engaged the attention of a number of workers for a large number of years, and in recent years Read and his collaborators have paid much attention to this question. Menthol contains three asymmetric carbon atoms, and the problem of the configuration of Menthol, neo-Menthol, iso-Menthol and neo-iso-Menthol and their relationship to Menthone and iso-Menthone, discussed in detail, is one of the outstanding developments since the publication of the first edition. The relationship of the optically active menthols to 1-Piperitone is also now clear.

The formula originally assigned to irone by Tiemann and Kruger has undergone revision at the hands of Ruzicka and his collaborators. A study of the ozonolysis followed by oxidation with chromic acid led to the isolation of trisubstituted pimelic, adipic and glutaric acids, which leave no doubt that irone has a seven-carbon-atom ring structure. The carbon skeletons of the acyclic and alicyclic substances may be considered to be built up by the fusion of isoprene nuclei, and this has proved a greatly reliable working hypothesis for the elucidation of structure. It should, however, be regarded only as a working hypothesis since several exceptions are known. No very satisfactory conclusion has yet been arrived at concerning the origin and function of terpenes and their oxygenated derivatives produced by plants.

In this edition, as in the previous one, the development of the views on the constitution of the various terpenes has been traced in a very clear manner; and indications of further research necessary to settle outstanding questions have been pleasantly treated so that the student of terpene chemistry will find no difficulty in following the trend of thought.

The book is an outstanding contribution in the field of organic chemistry in general, and terpene chemistry in particular.

K. N. M.

**Modern Gas Turbines.** By Arthur W. Judge. (Messrs. Chapman & Hall, Ltd., London), 1947. Pp. xii + 311. Price 28*sh.*

The gas turbine has already proved itself to be a serious rival to the reciprocating engine in some important fields of use. Granted the requisite knowledge and facilities, it can be cheaper to make than corresponding reciprocating engines; moreover, moderate metallurgical advances in certain directions will greatly increase the extent to which the gas turbine can outrival reciprocating engines. Thus, it may be good policy for India not to contemplate eventual manufacture of certain larger and more difficult types of reciprocating internal combustion engines but, instead, to go direct to gas turbines. It is thus patent that the subject of the book under review has a special interest for India.

To those who require to assess the possibilities and limitations of gas turbines for various fields of application, Mr. Judge's clear exposition will be of considerable help at the present stage. The author gives a brief history of the development of gas turbines and follows this with some general considerations. He then outlines the fundamentals of gas turbine thermodynamics and discusses gas turbine efficiencies and how to improve them. There follows a chapter on closed-cycle gas turbines and another on exhaust-gas turbines for supercharged engines. The next chapter deals with gas tubines for aircraft. This relates mainly to jet-engines as more experience has been gained with these engines than with those which deliver power through shafting. The concluding two chapters concern typical applications and performances of gas turbines, and materials for gas turbines. There are two short appendices which comprise notes on turbine-blade design and a description of some blade-fixing methods.

A considerable bibliography is given for the guidance of those who need to study particular aspects of the subject more fully. Important further contributions continue to appear in technical literature but the references given extend into 1946.

The book is not a design manual. It is largely descriptive, but fundamental principles and facts are stated thus forming an excellent introduction to the subject.

Little is given concerning dynamical aspects of gas-turbine design, such as balance, whirling, vibration of turbine discs and blades centrifugal and temperature stresses, high-speed bearings, and so forth. To a large extent these are covered by manuals on steam turbine design, but the gas turbine has its own special dynamical and stress problems. Again, heat interchangers for gas turbines are referred to only diagrammatically. However, it is to be realised that there is limitation to information released.

The book is clearly printed and is well-illustrated by numerous graphs, drawings and photographs.

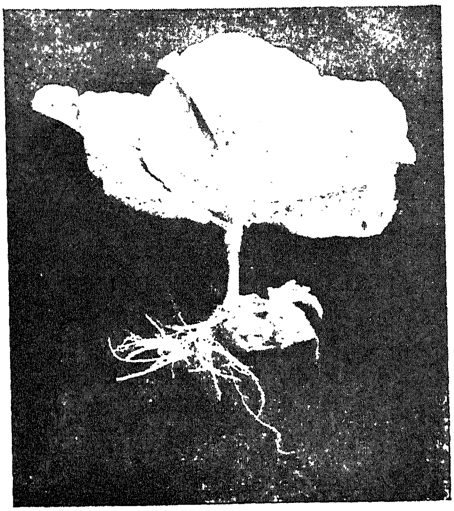
B. C. CARTER.

# SCIENCE NOTES AND NEWS

## Cabbage Crinkled-Leaf Var. belonging to the Genus Brassica

Dr. T. S. Sabnis from Cawnpore writes:—

One of the cabbage plants of the crinkled-leaf variety did seem to develop a proper head. When it was dug out, it showed a head-like



structure developed near one of the lateral roots (fig.). It may be a phenomenon of proliferation of buds from the root.

## National Institute of Sciences of India: Elections

At the annual general meeting of the National Institute of Sciences of India, held at Patna on January 1, the following new fellows were elected: Dr. B. S. Bhimachar, Fisheries Officer with the Government of Mysore, Bangalore; Pratap Chandra Bose, Chief Engineer, Corporation of Calcutta; Dr. Satya Charan Chatterjee, Head of the Department of Geography, Patna College, Bankipur, Patna; Jehangir Fardunji Dastur, Head of the Division of Mycology, Indian Agricultural Research Institute, New Delhi; Dr. Arun Kumar Dutta, Reader in Physics, Dacca University; Dr. Rukmini Kishore Dutta Roy, Geological Survey of India, Calcutta; Dr. Robert E. Heilig, Chief Physician, Jaipur; Dr. Kolar Ramakrishna Krishnaswami, Director of Industries, Bihar, Patna; R. A. MacGregor, formerly Chief Metallurgist to the Government of India, Calcutta; Ganesh Chandra Mitter, Chief Assayer, His Majesty's Mint, Bombay, and Honorary Professor of Industrial Chemistry, Royal Institute of Science, Bombay; Dr. Mahadeo Atmaram Moghe, Professor of Zoology, College of Science, Nagpur, and Head of the Department of Zoology and Dean of the Faculty of Science, Nagpur University; Dr. S. P. Raju, Director of the Engineering Research Department, H.E.H. Nizam's Government, Hyderabad, Deccan; Dr. Srinivasa Ramanujam, Central Potato Research Institute, New Delhi; Dr. Subbarao Ramachandra Rao, Professor of Physics, Central College, Bangalore; Dr. Jyotis Chandra Ray, Director, Indian Institute for Medical Research, Calcutta.

## Royal Asiatic Society of Bengal

The following are the recipients of Medals of the Royal Asiatic Society of Bengal:—

*Barclay Memorial Medal.*—Rai Bahadur K. C. Mehta.

*Joy Gobind Law Memorial Medal.*—Dr. Lieven Ferdinand de Beaufort of Amsterdam.

*Paul Johannes Bruhl Memorial Medal.*—Prof. S. R. Bose.

*Dr. Bimala Churn Law Gold Medal.*—Dr. B. M. Barua.

*Sir Jadunath Sarkar Gold Medal.*—Sir P. S. S. Pissurlencar, Nova Goa.

## Madras University Prizes

Candidates are invited to submit theses for the award of the following prizes awarded by the University of Madras: Sir William Wedderburn Prize (1948); The Maharaja of Travancore Curzon Prizes (1948-49); The Gokhale Prize (1948-49); and The Shankara Parvathi Prize (1948-49).

The subjects and last dates of submission of theses, the values and conditions of award and other particulars may be found in Vol. I, Pt. I, Appendix F of the University Calendar, Madras.

## International Geological Congress

The eighteenth session of the International Geological Congress will be held in London during the period August 25 to September 1, 1948. Prof. H.H. Read is the President-designate of the Congress.

Full details may be obtained from the General Secretaries of the Congress, Geological Survey and Museum, Exhibition Road, London, S.W. 7.

## International Congress of Anthropological and Ethnological Sciences

The third session of the Congress will be held at Brussels Teruveren during August 15-23, 1948. The President will be Prof. Ed. De Johghe and Secretary Prof. Frans M. Alberechts. Correspondence should be addressed to the Secretary, Muscee du Congo Belge, Teruveren, Brussels.

## Captain Inderjit Singh

Captain Inderjit Singh, F.A.SC., Professor of Physiology, Dow Medical College, Karachi, has been appointed Professor of Physiology, Medical College, Agra.

## Army Medical Training

India's armed forces will soon have their biggest medical training centre established in Poona. The main nucleus of the centre will be provided by the Army Medical College, already functioning at Ganeshkhind in Poona, and it will bring about a co-ordination in the activities of this College and other similar military institutions, such as the Central Pathological Laboratory, the Blood Transfusion Centre, the School of Radiology and the Typhus Research Station.

## Scientific Education through Films

Mr. K. C. Reddy, Chief Minister, Mysore, inaugurated the Scientific Film Society on the 29th February in Bangalore.

Prof. M. S. Thacker of the Indian Institute of Science, the Vice-President of the Society, welcoming the Chief Minister, stressed the need for such a society to educate the people in scientific progress and technical developments through the medium of films.

The Scientific Film Society, of which Sir J. C. Ghosh is President, is the first of its kind in India. Its membership is open to all. The Society proposes to produce and exhibit films on scientific subjects in a way which can be easily understood by the common man.

## Donation for Electro-Chemical Research

Dr. R. M. Alagappa Chettiar has made a munificent donation of Rs. 15 lakhs towards the establishment of an Electro-Chemical Research Institute in South India under the auspices of the Indian Research Council.

The Governing Body of the Council has sanctioned a sum of Rs. 6·5 lakhs for the renewal of 100 research schemes which are in operation in various universities and research institutions all over India under the auspices of the Council.

The Governing Body of the Council of Scientific and Industrial Research sanctioned the following new schemes of research entailing a cost of Rs. 87,000 and recommended by the Board of Scientific and Industrial Research, which also held its meeting on February 5, in New Delhi, under the presidentship of Pandit Jawaharlal Nehru: (1) Investigations on uranium, thorium and radium content of Madras granites and gneisses, and their intrusive suits, including the Cuddapah traps, by Dr. R. S. Krishnan. (2) Recovery of primary metals from non-ferrous scrap, by Mr. G. C. Mitter. (3) Investigation of a general effect of light on the electrical conductivity of systems activated by various types of discharge, by Dr. S. S. Joshi. (4) Study of the properties of crystalline quartz, particularly the piezo-electric, optical and twining properties in relation to its crystal structure, by Dr. Bishambar Dayal Saxena. (5) Scheme of research on synthetic fibres from proteins, by Sir S. S. Bhatnagar. (6) Preparation of vinyl plastics from alcohol and chlorine, by Dr. S. K. K. Jatkar. (7) Pilot plant investigations on the production of acetic acid from ethyl alcohol, by Sir J. C. Ghosh, (8) Effect of radiation on moulds, bacteria, etc., in relation to their metabolism, by Dr. B. C. Guha. (9) Manufacture of vitamin C from sorbose, by Dr. M. Damodaran. (10) Study of surface-active higher alkyl ammonium actions as antibacterials, by Dr. M. Damodaran. (11) Study of Microbiological methods for the estimation of complex organic substances of industrial and nutritional importance, by Dr. M. Damodaran. (12) Preparation of phosphanilic and related substances, by Prof. S. V. Bhide.

## Leather Technology

It has been decided to locate the proposed Institute of Leather Technology at Guindy under the name of the Indian Leather Research Association.

This decision followed discussions which Sir Shanti Swarup Bhatnagar, Director of the Council of Scientific and Industrial Research, Government of India, had with Mr. H. Seetharama Reddi, Minister for Industries, Madras.

## Power Alcohol in India

The Commerce Minister to the Government of India, Mr. C. H. Bhabha, introduced in the Dominion Parliament a Bill to provide for the development of the power alcohol industry on the 1st of March.

The statement of objects and reasons of the Bill says: "The development of the power alcohol industry is of national importance both from the point of view of using the molasses which would otherwise be wasted, and of creating in the country the nucleus of an industry which would be of importance in times of emergency. The utilisation of power alcohol would also reduce the price of sugar and reduce our dependence on petrol. It would, however, not be possible for most of the provinces producing molasses to absorb their total production of power alcohol within their own limits. It is, therefore, necessary to adopt measures to utilise their surpluses in other provinces in which production would not be sufficient to meet their requirements.

The panel for the development of sugar, power alcohol and food yeast industries which was set up by the Government of India recommended that admixture of power alcohol with petrol should be made compulsory for the whole country and enforced in such areas as are notified from time to time. The Industries Conference, held in December 1947, in which representatives of Provincial and State Governments participated, also unanimously passed a resolution in support of the proposed legislation.

## Metal Films by Evaporation

A continuous process of applying, by evaporation, films of metal to the surfaces of sheet materials has been developed by National Research Corporation, Cambridge, Massachusetts.

While such metals as aluminium have long been applied to the surface of glass or other material by batch methods, their quick, continuous application to continuous rolls at high speeds has not been practical until now. The National Research process applies extremely thin films of aluminium, silver, gold, zinc, copper and other metals to the surfaces of papers, textiles and various plastic sheets at linear speeds of hundreds of feet per minute.

Because of the extreme thinness of the film, the flexibility of the base material is not affect-

ed; and the moisture vapour transmission is reduced. Adhesion varies with the material. Finish is limited only by that of the base material, and on polished surfaces the brilliance exceeds that of foil. The method is claimed to be inherently more practical and economical than the rolling of foil, and its cost is materially lower.

At present the process recommends itself for use in decorative materials of great variety —wrapping papers, ribbons and novelty fabrics and particularly those packing materials in which beauty and novelty are the selling features. Various electronic uses have also been tested. Capacitors or condensers formed from zinc-coated paper have self-healing qualities, promising longer life to such units.

## Radar Detects Meteor Showers

Radar has been pressed into service in the detection of Meteors reaching the earth. So far, it was only possible to study them only during nights, as they were not visible during the day. The possibility of studying them by day-time is a result of war research in Great Britain.

During the war, the radar instruments proved very reliable in keeping a watch over V-2 rockets coming from the Continent—both day and night. But strangely enough they recorded radio echoes repeatedly even when there were no V-2's in flight. This riddle was soon solved by Dr. J. S. Hey of the Army Research group. The mysterious echoes came, not from German rockets, but from Meteors.

It should be noted that radio waves are not reflected from the "Falling Stars" themselves, the latter usually being very small—often no bigger than a pea or a pin-head. But these minute stone or earth particles from space rush with terrific speed towards the earth, a hundred times faster than a gun bullet. When meteors reach the earth's upper atmosphere, at a height of about 100 km., the friction—the rebounding action of the air molecules—causes such intense heat that the particles normally burn. Hence the flash of the falling star can sometimes be observed for several seconds in the night sky.

During this process ionised gas molecules are created and remain in the wake of the meteor like the tail of a comet, and it is these charged gas particles which throw back the radio waves and are visible on the radar instruments. It has been shown that waves of 5-30 metre length, such as were used during World War II with radar instruments for military purposes, also give good results in meteoric research.

The chance discovery of Dr. Hey gave rise to intensive research work after the war in Britain. One decisive advantage was that radar observation could be made as well by day as by night and is quite independent of weather influences. It is, therefore, possible to follow the path of meteors during day-light and with a very cloudy sky.

As the meteor showers do not arrive until after midnight and continue on into the day, astronomers had formerly only been able to observe a part of the shower. When radar instruments were, however, set for this purpose during last May, it was found that the shower did not diminish in daylight but, on the contrary, increased, and by mid-day had attained such intensity hitherto unknown in a regular meteor shower. This phenomenon was still to be seen during the following days and throughout the month of June and into July.

## Manufacture of Phosporus in India

*The Journal of Scientific and Industrial Research* (October 1947) reports that a pilot plant for the manufacture of 1 ton of phosphorus per day from rock phosphate has been designed at the Indian Institute of Science, Bangalore.

The annual consumption of red phosphorus in India was about 150 tons before war. The present-day requirements of Indian match and non-ferrous metallurgical industries is estimated to be about 200-250 tons.

Most of the requisite equipment for the proposed pilot plant can be fabricated in India, while the raw materials are readily available. The capital expenditure of such a plant would be about Rs. 3 lakhs, while the building and working capital will cost about Rs. 2 lakhs. The cost per pound of amorphous red phosphorus produced is estimated at 10 as. 7 p.

## Distilled Sea Water for Irrigation

The sun's rays are to be utilized in an attempt to distil sea-water for irrigation purposes in the Kathiawar, Rajputana and Sind desert areas.

Dr. J. Saidman, Director of the Pan's Institute of Actinology, Paris, has arrived in India on an invitation from the Jam Sahib of Nawanagar, where preliminary experiments on the plan are to be conducted. A resolving solarium already exists in the State.

Under the scheme, water will be boiled with the aid of the solarium, and converted into vapour. The vapour will be converted into pure water, and transmitted through large pipes to cultivated tracts. The experiment is expected to be under way by the end of next year. Dr. Saidman was confident that it would prove successful, and, if machinery were available, he hoped that the entire scheme would be completed within ten years.

Large quantities of salt would also be available. While it would be fit for human consumption, the major portion could be used for manufacturing chemicals.

## Dr. P. Venkateswarlu

Dr. P. Venkateswarlu, who is now working with Professor Niels Bohr as an International Research Fellow, has been elected to a post-doctoral research fellowship at the University of Chicago.

## Nutritional Value of Vanaspati

A comprehensive scheme of research, including nutritional and feeding tests as well as chemical studies from the scientific point of view of Vanaspati was approved for investigation at the University College of Science, Calcutta, The Indian Institute of Science, Bangalore, The Nutrition Research Laboratories, Coonoor, and the Department of Chemical Technology, Bombay. This scheme was drawn up by the Vanaspati Research Advisory Committee set up by the Council and will be financed by the Vanaspati Manufacturers' Association.

## Col. Sokhey

Col. Sir Sahib Singh Sokhey, Director of the Haffkine Institute, Bombay, left Bombay on March 15 to attend the meeting of the World Health Organisation's Experts Committee on Biological Standards to be held at Geneva from March 18th to 31st. Sir Sahib Singh will later proceed to America in connection with the penicillin project of the Government of India and also attend the International Congress on Tropical Medicine to be held at Washington in May.

## Natural Resources of States

It is learnt that a large number of major Indian States have decided to establish an "Economic Chamber of Indian States" with a central office at New Delhi to formulate a co-ordinated economic policy for the best utilisation of the natural resources of these States and to enrich them with rapid industrialisation and extend their markets to foreign countries.

In this connection, H. H. the Gaekwar of Baroda convened a conference of Rulers in Calcutta on March 14.

The Conference discussed the question of appointing a permanent Advisory Committee with scientists, meteorologists, technicians and engineers to survey and devise measures for the utilisation of the resources of the States and a Development Board which will work as *liaison* between the Development Departments of the Government of India and those of the Indian States.

## A New Plastic Material

The Council of Scientific and Industrial Research has developed a new patented process ready for exploitation for the manufacture of resin-impregnated sheets and boards and drawn laminated mouldings. By this process a large variety of attractive moulded articles can be manufactured which are superior to and more economical than those made from powder mouldings.

Powder-moulded products are brittle and break easily on impact whereas drawn laminated mouldings possess an extraordinary degree of toughness and will not break. Also articles possessing intricate shapes can be produced from impregnated sheet fabric because of the inherent properties of laminate materials.

By this process articles possessing attractive styles, fancy shapes, colours and patterns, can be produced. The manufacturer is thus enabled to cover a wide range of consumer goods from household articles, furniture, decorative objects, building materials, gears, children toys and stationery.

This process utilizes ordinary resins, jute, cotton and other material available in India and the manufactured cost of impregnated laminated moulded articles is very low.

## South Indian Science Association

The Silver Jubilee of the South Indian Science Association was celebrated on the 25th and 26th of this month in Bangalore. The celebrations were inaugurated by Mr. K. C. Reddy, Prime Minister of Mysore. Sir C. V. Raman delivered the Jubilee Address on the first day. On the 26th, a symposium on "Nutrition in South India" and a discussion on the "Medium of Instructions in Science Subjects in Indian Universities" were held. Scientific and Educational Films were also exhibited on the occasion.

## Publications Received

*Conference on Industrial Development in India, New Delhi, 15th to 18th December 1947, Agenda and Notes with Reports of Departmental and Conference Committees and Resolutions passed.* (Published by the Manager, Government of India Press, New Delhi), 1948.

*Conference on Industrial Development in India, New Delhi, 15th to 18th December 1947, Proceedings.* (Published by the Manager, Government of India Press, New Delhi.)

*Patent Office Handbook.* Seventh Edition. (The Manager of Publications, Delhi), 1947. Price Re. 1.

*Dyeing Properties of Indian Cottons.* By D. L. Sen and Nazir Ahmed. (Indian Central Cotton Committee Technological Laboratory), 1947. Price Annas 12.

*Estimation of Wax Content and Feel of a Cotton from Its Physical Characters.* By C. Nanjundayya. (Indian Central Cotton Committee Technological Laboratory), 1947. Price As. 3.

*Report on the Discolouration of Bleached Bamboo and Grass Pulps During Storage.* By M. P. Bhargava and P. C. Bhatra. (The Forest Research Institute, Dehra Dun), 1947. Price Annas 5.

*Field Songs of Chhatisgarh.* (Published by The Universal Publishers, Lucknow), 1947. Price Rs. 3-12.

*Annual Report on the Health of the Army in India for the Year* 1944, Vol. VII, Pt. I. (Published by the Manager of Publications, Delhi), 1947. Price Rs. 2-2.

223-48 Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore

Current Science

Vol. XVII] APRIL 1948 [No. 4



# CONSTITUTION OF INDIAN UNIVERSITIES*

IN his recent Convocation Address to the Travancore University, Sir John Sargent made two basic assumptions on which the main thesis of his address was based. The first was "that standards in Indian Universities are on the whole lower than in most Western Universities". He might, had it been relevant to his theme, have drawn a conclusion from this assumption and asserted that Indian Universities are held in less respect, both by their own alumni and by the public generally, than British Universities. When considering the constitution, the work, and the public estimation, or rather the estimation and respect of the learned world, of a young university like ours, it may be helpful, if we try to analyse some of the reasons why the universities of the West have earned such high and universal respect.

I am convinced that this great respect in which the universities of the West are held is inseparably linked with the absolute freedom which they enjoy, for they are, both constitutionally and actually, free from all extraneous interference or pressure. We in India have been accustomed for many years to pay lip-service to the ideals of "academic freedom" and "university autonomy", though with an uneasy conscience, for we are all conscious that universities in India have never been genuinely *free*. University autonomy and freedom, if it is to be genuine, must mean freedom from all forms of non-academic influence, authority and power.

The foundation of the freedom and autonomy of British Universities is to be found firstly in the method by which these universities are created. They are not founded by Acts of Parliament, but by Royal Charter granted by the Sovereign. Neither at the foundation nor at any subsequent amendment are the affairs or constitutions of British

* Abstract of an address by Mr. H. C. Papworth, Vice-Chancellor of the University of Travancore to the Senate of the University delivered on 8th March 1948.

Universities debated in Parliament, and in this way the possibility of any political interference or pressure in university affairs is completely removed. It may legitimately be regretted that the first three universities in India were founded in 1857 by a legislative Act and not by a Royal Charter, for this precedent undoubtedly set the norm for the foundation of Universities in India ever since, and the growth of political consciousness and the natural evolution of legislatures have been continual brakes upon any growth of real academic freedom.

Now that a new era has dawned, it should be possible, if we have the will and the necessary self-sacrificing and self-denying qualities, to remove universities from the control of legislatures, central or provincial, and to decree that the foundation of new universities and amendments to the constitutions of existing ones should be the prerogative of the Governor-General or of the Rulers of the States. This is the first method by which academic freedom and the respect which follows from it are secured to British Universities; and the history of the past ninety years seems to suggest that without it genuine autonomy and academic freedom for Indian Universities are impossible. This method of foundation was fortunately adopted in Travancore, this University having been founded by a Proclamation and Act of the Sovereign, and not by an Act of the legislature. I sincerely trust that all future amendments to this Act will be promulgated in the same manner. If this be done, it will be a considerable help in preventing the University from becoming the plaything of politics.

There are many other ways, apart from making universities dependent for their existence and constitution on a politically constituted legislature, in which undesirable interference or pressure can be exerted to the curtailment or negation of autonomy and freedom, and in referring to this question too, it is natural that one should look to the condition of British Universities as providing the ideal.

In the first place, the British Parliament sends no representatives to the Senates or other governing bodies of British Universities. One can legitimately wonder why, if it is not for the deliberate introduction of political interference and pressure, provision is made for the legislatures to send some of their members to the Senates of Indian Universities.

It has often been a matter of concern to many who have been brought up in another tradition that the Senates of most Indian Universities have been modelled on the plan of a legislative assembly. Further, the deliberations of the authorities of British Universities are not open to the press and are never reported, except by official announcements which a university may send to the press for public information. So there is no incentive for that partisan type of argument and debate which sometimes disfigures the deliberations of university bodies in India.

It is true that on the Courts or Councils of many British Universities, which correspond to the Senates of Indian Universities—the Senates of British Universities being composed exclusively of the Professors of the University—there are, in addition to educationists, representatives of other bodies and corporations. For example, the Court of Governors of the University of Manchester and of the larger cities and towns in the county of Lancaster. But these representatives are not 'elected'; they are chosen or picked out by their colleagues on the bodies of which they are members, and nominated by them as the most suitable persons to serve on a university authority. The same people might not be the most suitable persons to serve, for instance, on the County Transport Board, for which other persons would be chosen and nominated, who might not, in turn, be at home on a university authority.

In addition to these wisely chosen representatives of public authorities, we find that many British Universities enlist the help of the professions, the learned societies, business and industry. Leeds University, which is situated in the heart of a big industrial area, has on its Court a number of representatives chosen by such associations as the Clothworkers' Company, the Skinners' Company, the Drapers' Company, as well as by the professional bodies like the Yorkshire Board of Legal Studies. The Universities of Liverpool and Sheffield have on their Courts a representative of all the other universities in the country nominated by the Chancellor of each university. In addition, they have a representative nominated by the Royal Society, the Royal Colleges of Physicians and Surgeons, the Law Society, the General Council of the Bar, the Institutions of Civil and Mechanical Engineers, the Royal Institution of British Architects, the Institution of Naval Architects and the Iron and Steel

Institute. It will be clearly seen that all the representatives so chosen are personally and daily concerned, each in his own professional or business sphere, with the work the universities do and with the fitness of the products they turn out. There are no elections in this matter. Fellows of Royal Societies and other self-respecting professional and business men would not offer themselves for 'election', and bear the indignity of standing against one another as candidates. That is one of the elements of elections which makes elections out of place in university spheres.

This freedom which British Universities possess to secure only the right men in their assemblies is a priceless gift of the Royal Charter, and it might be well worth fighting for in India.

With the advent of constitutional independence in India, have not the time and the opportunity arrived for us to consider these things and to take steps to secure the academic freedom of our universities and to raise their present somewhat middling status and reputation in the learned world ? If we are to do this, we must first tackle our constitutions, in which, if the British Universities can serve as a model, there is no room either for political or so-called 'popular' elements. Universities cannot be efficiently run either by politicians or by the public ; they should be the most secluded and exclusive institutions in our midst. Then alone can they remain untarnished and on a higher level than any other secular institution.

So, instead of the so-called 'constituencies' —the very word has a political connotation and, therefore, quite inappropriate in university parlance—which 'elect' so-called 'representatives' to the Senates of many Indian Universities, one would like to see their places taken by professional and commercial organizations, which are deeply and genuinely interested and concerned with the education we give, and, more important still, with the products we turn out. It is not the politicians or quasi-politicians, but the great professions and businesses of the country which are most intimately concerned and handicapped when the universities turn out so many misfits. One would, therefore, like to see a complete change of outlook on the part of the public generally, and a thorough overhaul of constitution of university assemblies. In addition to experienced educationists, principals of colleges and professors of university status, room should be made in the Senates of Indian Universities for representatives nominated by the Institution of Engineers of India, the Medical Councils of India, the Bar Associations, the Research Institutes, the Defence Forces, the Chambers of Commerce, the Trades Associations, the Mill-Owners' Associations, the Planters' Associations and other respected bodies and societies of this kind, whose unprejudiced guidance as to what they expect our highest seats of learning to achieve would be of inestimable value.

If this were done, and if our university constitutions were remodelled on these lines, we could eliminate all elections and all official nominations from the Senates of universities. This, I am convinced, is an ideal worth achieving.

---

## LANGUAGE MEDIUM OF SCIENCE IN UNIVERSITIES

At the Silver Jubilee Celebrations of the South Indian Science Association in Bangalore, a discussion was held on the 26th March on the subject of the Medium of Instruction in Science in Indian Universities. Eminent scientists, administrators and educationists participated in the debate which was presided over by Sir C. V. Raman.

Introducing the subject of discussion, the President emphasised the backwardness of India in Science education and research, and pointed out that, for the uninterrupted progress of science in the country, free interchange of knowledge with the world stream of scientific thought was indispensable.

The discussion took into consideration all the important aspects of the question including the necessity for bringing the knowledge of the progress and potentialities of modern science to the mass of people in India, most of whom are ignorant of English. The imperative need of scientists and technologists in India to keep always in contact with international work in their respective fields of specialisation was also considered. It was unanimously agreed that the objective of mass education in science could be best achieved by teaching science in secondary schools in the language of the province, retaining, however, the current English scientific terminology. In the universities and advanced institutions of scientific research, the speakers recommended that science should continue to be taught and scientific work to be published in English for a number of years to come, to avoid hampering the progress in the scientific advancement of the country.

# ROSTER OF SCIENTIFIC AND TECHNICAL PERSONNEL, INDIA

T. N. RAMACHANDRA RAO
(*Indian Institute of Science, Bangalore*)

THE Roster of Scientific and Technical Personnel is a project which will make available in a central place, an index of all citizens of India, who have special scientific or technical qualification.

The main object of the Roster is to accurately map the human wealth of the nation. The rapid advance of scientific and technical knowledge makes it necessary that the nation should be in a position to call upon its specialised personnel in rapid and effective manner.

In Britain, by 1939, a register of scientific and technical personnel was completed under the supervision of the Royal Society. In the following year there was established in America a Council under the joint management of the National Resources Board and the Civil Service Commission, to compile a national roster. By 1943 a great deal of valuable information had been collected with a total of 630, 770 and consisting of physicians, dentists, veterinarians, chemists, engineers, physicists, mathematicians, geologists, economists, biologists, psychologists, etc.

In India, it is proposed to compile a Roster of Scientific and Technical men, under the auspices of the National Institute of Sciences, Delhi. Last year the National Institute made a country-wide appeal to the scientific workers to help them with the necessary information to compile the roster. But, judging from the recent appeal issued by the Prime Minister, the response was poor. Consequent on this decision, a small sub-committee was appointed to collect data in all the four zones (North, South, East and West) of India, concerning scientific man-power resources of the Nation.

The success of such a venture depends largely on the willing help the scientists and technologists render by furnishing necessary information at an early date; for to-day the question before the scientists in India should be, not "where they can serve" but "where they can serve best".

Here is given a brief resumé of the methods of compilation and working of the Roster.

The Roster should include all scientific and technical workers in India, who have either a University degree or suitable technical training under the guidance of qualified scientists.

The necessary information concerning individuals is secured by sending each professional man a general questionnaire to get qualitative information on about 20 items such as (*a*) geographical area, (*b*) linguistic ability, (*c*) technical qualification, (*d*) foreign travel, and such others.

There are two lists under which information is collected: one is the *'General List'* and the second is the *check list* for details of specialisation. The general list is prepared under the following broad groups with special check lists in each:—

(A) (*a*) Administration and Management, (*b*) Engineering and related fields, (*c*) Humanities, (*d*) Medical Sciences, (*e*) Physical Sciences, (*f*) Agricultural and Biological Sciences, (*g*) Raw Materials and Manufactured Products, (*h*) Social Sciences.

(B) The special check list will be drawn up by a committee of experts in each field and will reveal the special branches in which the candidate is proficient. This can be best illustrated by giving a check list related to *Engineering and related fields*:

Aeronautics, Architecture, Automotive, Chemical, Civil, Electrical, Heating, Ventilating, Refrigeration and Air-Conditioning, Mining and Metallurgy, Industrial Design, Motion Pictures, Mechanical, Naval-Architecture, Marine, Radio, Safety, Sanitary, Testing and Materials, Transit and Traffic Engineering.

With information thus collected, the Roster will be planned on a card-index system; with complete information concerning each individual. To give an idea of such a compilation, here is recorded the distribution in professional

| Field of Specialisation | Extent of Education | | | |
|---|---|---|---|---|
| | Doctors Degree | Masters Degree | Bachelors Degree | Total |
| 1 Aeronautical | 1 | .. | 11 | 12 |
| 2 Automotive Engineering | .. | 1 | 8 | 9 |
| 3 Bacteriology, Immunology | .. | .. | 7 | 7 |
| 4 Botany | .. | 3 | .. | 3 |
| 5 Chemistry | 14 | 45 | 36 | 95 |
| 6 Chemical Engineering | .. | 7 | 23 | 30 |
| 7 Civil Engineering | .. | 1 | 2 | 3 |
| 8 Electrical Engineering | 1 | 12 | 30 | 43 |
| 9 Genetics | 1 | 2 | .. | 3 |
| 10 Geology | .. | 2 | .. | 2 |
| 11 Heating (Air-conditioning) | .. | .. | .. | .. |
| 12 History and Political Science | .. | .. | .. | .. |
| 13 Languages | 2 | .. | .. | 2 |
| 14 Mechanical Engineering | .. | .. | 3 | 3 |
| 15 Mining and Metallurgy | 2 | 5 | 9 | 16 |
| 16 Physics and Astronomy | 2 | 7 | 4 | 13 |
| 7 Horticulture and Agriculture | .. | 2 | 1 | 3 |
| 18 Sociology | 1 | .. | .. | 1 |
| 119 Statistics | .. | 1 | .. | 1 |
| 20 Zoology | 1 | .. | .. | 1 |
| | | | | 247 |

fields of men (241) and women (6) at the Indian Institute of Science, Bangalore, together with a classification of the academic training of the Scientific Personnel.

Once started and organized, the Roster will be a continuous census of the scientific man-power of the nation. It requires expert administrative staff to develop all aspects of the

Roster, and it means funds. But the expense in maintenance and its continuation are very little as compared with other projects undertaken to conserve our national resources. The Roster will be of value to many constructive activities of the nation; such as (a) the effective use of the scientific talent available in the country, (b) to reveal the gaps in the present unco-ordinated growth of science and technology, (c) to help proper equipment of College faculties, (d) to supply service personnel to industries, (e) to suggest alternative names where team-work is likely to be broken up, (f) to safeguard going concerns like education and research by conservation of present personnel and to stop the drift of scientific and technical men to purely administrative lines.

It seems evident, therefore, that in times of war as well as peace, a central list of this sort will be a National Asset for the effective use of its Scientific and Technical man-power. It is up to the Scientists and Technologists in India to render all help towards an early compilation of the National Roster.

---

## RESUMÉ ON SERIES CAPACITORS

H. V. GOPALAKRISHNA

(*Indian Institute of Science, Bangalore*)

THE American transmission and distribution system during the war had to be loaded to its more than maximum capacity calling on the resources of the engineers resulting in notable strides of improvement in the construction and protection of power capacitors to meet the exigency. However, in India, during that period, when imports were restricted and hence no further additions of plant were feasible, the exploring of raising of the capacity of the existing system was hardly given any attention and power was denied to many industries some of which could have been supplied power and gone a long way in the industrialisation of the country which we are all seeking to-day. Furthermore, heavy voltage drops could have been avoided and helped in the current to be delivered at an optimum voltage to all the consumers connected to the power system. In this respect the response of capacitors connected in series with the lines, otherwise called Series Capacitors is highly interesting.

Improvement in voltage regulation can be effected in several ways. The method of transmitting more power at higher voltages through larger wires or more number of parallel lines will involve higher cost of line construction and transformers and a corresponding increase in operating cost. Moreover, very little voltage regulation will be obtained by increasing the size of conductors beyond a certain limit because the controlling factor is chiefly the inductive reactance of the line. Induction regulators common now on rural lines have high internal losses and are not instantaneous in action. A change of voltage is necessary to actuate them and a time factor is involved to effect the correction. It might so happen that by the time correction is effected the demand for excess current has ceased and an overvoltage results. Synchronous Condensers for voltage regulation, in large vogue at present, have losses varying from about one and a half per cent. of their rating on very large sizes to about five per cent. of their rating on smaller sizes and the machines with their control equipment are complicated and require periodic inspection and proper maintenance. The Shunt Capacitors like synchronous condensers improve voltage regulation by improving power factor. If they are left on circuits at light loads a voltage rise will occur at the distribution points which may be as disadvantageous as too low a voltage.

Series Capacitors provide automatic voltage regulation from light load to full load changes in the circuit. They also tend to lessen the initial cost of a new circuit by making possible the use of a smaller size of wire for a given power with a given voltage drop. The reactance of a system has a predominant effect on the maximum power that could be conveyed over a line. It should be kept as low as possible and the method by which it could be reduced to a minimum is to alter the spacing which is, of course, governed by voltage, corona and mechanical considerations. The series capacitors nullify the inductive reactance of the line and transformers and it approximates the line to characteristics of direct current transmission. Their use enables the existing system to carry greater load than what could be handled by increasing the wire size.

It is common experience that due to reduced voltage induction motors sometimes start slowly or refuse to start through the action of the undervoltage device. Fluctuating, intermittent and suddenly applied loads such as, the working of the rolling mills, resistance welding machines impose difficult load conditions on the power system from the standpoint of feeder regulation and capacity. It is felt that these types of applications have a great future in our country since the use of electricity is playing a larger and larger part in welding, etc. From the economics point of view the power company cannot cater to such needs. Herein the series capacitors are of considerable advantage to other types of equipment for providing automatic voltage regulation.

The series capacitors have recently been used with success in improving the regulation of high frequency generators to supply power to induction furnaces. These generators are single phase, and the very nature of their design indicates that they have high reactance which causes very poor regulation.

On high voltage long transmission lines the series capacitors can be used to increase the stability limit of the circuits in which they are connected. They also find application in improving load division by alteration of the impedance of parallel circuits.

The series capacitors also excel other commercial apparatus in their characteristics of low losses which are of the order of 0·25 per cent. of their rating. Being static and sealed-off devices they require practically no maintenance or attendance; nor any specially prepared

foundations are needed for their installation. The series capacitors thus provide a broad field of service in power systems and may well be given thought to in the proposed network of transmission and distribution lines in India.

1. Shelton, E. K., "Series Capacitor Installation, N. Y.," *G. E. Review*, Aug 1928, **31**, pp 432–4. 2. Moler, C. C., "Series Capacitors Regulate Rural Voltages Economically," *Electrical World*, Sept. 1939, **23**. 3. Aliminsly M. I., "Application and Performance of Series Capacitors," *G. E. Review*, Nov. 1930, **33**, pp. 616–25. 4. Hill, W. S., "Series Capacitors Improve 4150 Volt Line Operation," *Ibid.*, Oct. 1933 **36**, p 461. 5. Dudley, C. L. and Snyder E. H., "Why Not Series Capacitors for Distribution Feeders" *Electrical World*, June 1930, **103**, pp. 942–5. 6. Buell, R. C., "Improved Voltage Regulation with Series Capacitors," *G. E. Review*. April 1937, **40**, pp. 174–9. 7. Lewis, J. J., "Largest Capacitor by Instantaneous Response Eliminates Stubborn Flicker, Originating in Industrial Load Off Residential Feeder" *Electrical World*. Nov. 1936, 7, **106**, pp. 3488–90. 8. Perreton, A. E., "Series Capacitors prove economical," *Ibid.*, Dec. 1936, **77**, p. 48. 9. Butler, J. W., and Concordia, C., "Analysis of Series Capacitor Application Problems," *A.I.E.E. Trans.*, Aug. 1937 Section, **56**, pp. 975–88. 10. Butler, J. W., "Capacitors and Circuit Performance," *Ibid.*, 1941, **60**, p. 408. 11. Allen, E. S., and Cantwell, J. L., "Effect of Series Capacitors upon Steady State Stability of Power Systems," *G. E. Review*., May, 1930, **33**, pp. 279–82. 12. Starr, E. C., and Evans, R. D., "Series Capacitors for Transmission Circuits," *A.I.E.E. Trans.*, 1942, **61**, pp 963–73. 13. Butler J. W., Paul, J. E., and Schœler, T. W., "Steady-State and Transient Stability Analysis of Series Capacitors in long Trrnsmission Lines," *Ibid.*, Feb. 1943, **62**, pp. 58–65. 14. Hoard, B. V., "Characteristics of a 400-mile 230 KV Series-Capacitor-Compensated Transmission System," *Ibid.*, Aug. 1946, pp. 1102–14. 15. Peterson, H. A., and Shrœder, T. W., "Abnormal Overvoltages Caused by Transformer Magnetizing Currents in Long Transmission Lines," *Ibid.*, Jan. 1943, **62**, pp. 34–42. 16. Schultz, S. E., "500-mile 230 KV Series-Compensated Transmission," *Electrical World*., Aug. 17, **1946**, p. 70-1. 17. Crary, S B., and Johnson, "A. C. Power Transmission Economics," *A. I. E. E. Trans.*, Aug. 1947, pp. 793–7.

## PROFESSION OF CHEMISTRY IN INDIA*

PROF. FINDLAY said that he had been sent by the Royal Institute of Chemistry to convey their greetings to their members in the Indian Dominion and to consult the Indian colleagues as to the best way in which the Fellows of the Royal Institute of Chemistry here in India could build up a strong professional body like that of the parent body in Great Britain.

The Royal Institute of Chemistry, he continued, came into being 71 years ago as a result of the pressing demands of an Act in Great Britain called "The Food and Drugs Adulteration Act". At that time there was no standard of chemical competence in Great Britain which could fulfil the aims and objects of the "Food and Drugs Adulteration Act". When such was the state of affairs the Royal Institute of Chemistry was brought into being in order to (1) prescribe a standard of scientific competence for the profession of chemists; (2) see that the standard is maintained; (3) arrange for courses to produce chemists of the proper standard; (4) hold examinations in order to decide the eligibility for membership; and (5) safeguard the interests of chemists and chemical engineers in fixing their salaries in Government Departments, Factories and other concerns.

Professor Findlay then referred to the education of young men and women in Britain who were unable to attend the university for their education. He narrated the practice followed in Great Britain in this respect. Examinations were held and National Certificates were issued to the pupils. The examination papers would be approved by a competent body appointed jointly by the Education Ministry and the Royal Institute of Chemistry. According to them the Senior National Certificate is equivalent to a B.Sc. degree. Those candidates who attained necessary efficiency, after about two years of approved work would be eligible for admission to the Royal Institute of Chemistry.

"At the present it is your intention," Professor Findlay said, "to build up new industries and to develop your old ones. Those of you who are qualified for the profession should organise a strong professional body and build up in India such a high standard for the membership that you could speak with authority as to what must be done in the best interests of the country. It will be found advisable to form local centres of your professional bodies where you could come together from time to time and discuss problems of paramount importance to the country and for safeguarding the interests of the profession of chemistry. The body should not work for the benefit of its members only. It should always bear in mind the public interest. When I landed in Bombay I suggested to my colleagues there to form the local centre and to make use of the machinery available in Great Britain. Since you have been conferring D.Sc. and PH.D. degrees in almost all the universities, there will be no difficulty for you to fix up the standard for this Certificate. There are about 100 members of the Institute of Chemistry in India; and I have been sent here to offer to you on behalf of the Royal Institute, any assistance that you might need. Any suggestion which you have to make regarding simplification or alteration of the rules in order to meet the needs of this country will be welcomed. It has been agreed, for the present, to set up four branches of the Institute in India—at Bombay, Calcutta, Delhi and one in S. India. When these local centres have been established, I hope they will realise the importance of their duties in India and undertake to enrol for their professional body all the chemists qualified to become members. You can also maintain a register of qualified chemists.

"The whole plan should be in collaboration with the Ministry of Education in India. But for the full support and co-operation of this Ministry in Great Britain we would not have been able to build up the Institution to the status it now enjoys."

* Summary Report of an Address delivered by Prof Alexander Findlay, D.Sc., F.R.S., on 17th March 1948, at the Indian Institute of Science, Bangalore.

# AGRICULTURAL PROBLEMS OF INDIA AFTER PARTITION*

ARABLE farming has been the predominant feature of Indian agriculture since times immemorial. Food crops cover the largest area followed by cash crops of different kinds. Mixed farming, including rearing of poultry, dairy farming and the growing of fruits and vegetables is practised by only a few. Vast bulk of the area under cultivation depends on an uncertain rainfall, the irrigated area representing only about 20 per cent. of the net area sown. The net result has been that the average yields per acre are low and compare unfavourably with those in the agriculturally advanced countries.

The shortage of food during the war made the Government awake to the importance of increased food production within the country, and special schemes were brought into operation for increasing food production. The Advisory Board of the Indian Council of Agricultural Research estimated that, for meeting the requirement of food for men and cattle in India, production must be increased by percentages ranging from 10 in the case of cereals to 400 in the case of oilcakes and other concentrates.

The revolutionary political changes of 1947, resulting in the exchange of population on a tremendous scale in some parts of the country, has accentuated certain long-standing agricultural problems and created certain fresh ones. The solution of the problems created by the accession of the food and cotton surplus areas in the North-West Punjab and Sind and the principal jute areas in East Bengal to Pakistan and the migration of four million people from Western Pakistan into the Indian Dominion can brook no delay.

It is most essential to co-ordinate the resettlement of refugees with the increased production of food and cash crops, by methods in harmony with the principles guiding India's industrial and social advancement. The All-India Congress Committee has very recently set up a sub-committee to evolve an economic structure which will yield maximum production without the creation of private monopolies and the concentration of wealth in a few hands. In respect of agricultural development, such a structure should, apart from securing rehabilitation of refugees, aim at achieving national as well as regional self-sufficiency in food production, at the same time guaranteeing balanced nutrition for all. The country's deficit in the long-staple cotton and jute should also be met with. The structure should also increase the cash income of the farmer and lead to the reconstruction and improvement of rural areas. Considering that low yields, poor quality produce, low wages and a very low standard of living, both for the agricultural labourer and the small farmer, are in no small measure due to the primitive methods and limited resources of the small peasant proprietors, it would appear that a solution of the country's agricultural problem lies in adopting 'group agriculture', employing modern methods with centralised farm management under expert supervision. Of the many different systems of group cultivation, 'co-operative farming' for the production of fruits, vegetables, poultry and dairy products and 'joint-stock company farming' for the growing of food, fodder and cash crops appear to hold the greatest promise of solving the immediate as well as the long-range agricultural problems of the country.

Farming by public utility companies should have the production of food grains as their primary objective. They should be financed jointly by the Government, farmer-producer and consumer and their policy determined by a Board representing all these interests. They should be under expert centralised management, the farmer-members actively working on the estates as partners and receiving an adequate share of the net profits as remuneration. The Government should receive a fixed percentage of the net profit as divided on the capital invested and in lieu of water rates, if any, and land assessment. The annual dividend on the investment of the consumer-members should be limited to a maximum of, say 10 per cent. The first option on the food grains which may be surplus to the legitimate requirements of the employees should rest with the Government. Training should be imparted to workers to increase their efficiency; they should also be provided with social amenities. The Government, for its part, should finance reseerch and experimental work needed for the area of operations of the companies.

A unique plan satisfying many of the principles mentioned above has been in operation in Sudan for the past twenty years in canal-irrigated areas of the Sennar Dam on Blue Nile. Here, a co-operative arrangement between the Government of Sudan, the cultivators and the managing company (The Sudan Plantation Syndicate) has resulted in the quick development of over 300,000 acres of irrigated area under the project. This plan with suitable modifications is advocated for the quick and scientific development of project areas, government lands as do not attract private cultivators in the beginning, and also for the existing cultivated areas where backward agricultural conditions prevail.

C. R. H.

* Summary of the Presidential Address delivered by Rai Bahadur Kalidas Sawhney to the Section of Agricultural Sciences, at the 35th Session, of the Indian Sci. Cong., at Patna, 1948.

# OVERSEAS SCHOLARS

IT is proposed to publish periodically lists of the overseas scholars sponsored by the Central and Provincial Governments and the Indian States. The matter which will, in the first instance, appear in instalments in the columns of *Current Science*, is expected to be issued as a consolidated "Directory" at a later date.

Overseas scholars returning to this country are cordially invited to send in to the Editor particulars of their academic distinctions, research experience and their permanent address.

# RECENT ADVANCES IN TROPICAL METEOROLOGY*

S. L. MALURKAR
(*Poona* 5)

INDIA is meteorologically the best equipped country in the tropics. A fresh approach in Tropical Meteorology would necessarily be of great use to India.

The rain associated with the S.W. monsoon feeds literally most of the persons in Asia. It is a good starting point and most other problems of tropical meteorology can be made to depend on it. Apart from what one learns in Physical Geography, extensive work has appeared on the subject.[1] Up to 1925, the idea of the S.W. monsoon was that it was due to the penetration of the 'S.E. Trades' into the northern hemisphere under the influence of the vast summer low pressure area over Asia. Blanford, Hemraj, Simpson, Doraiswamy Iyer and Normand took this view. The Indian monsoon was statistically connected with the high pressure area over S. America. The transport of fresh air from there to India was assumed to take place along the geographically shortest path, *i.e.*, across extreme S. Africa and the 'roaring forties', then up along the 'S.E. Trades' almost up to the coast of E. Africa and then from the E. African coast to India across the Arabian Sea. As the idea is only implicit in papers by Hemraj, Walker and Doraiswamy Iyer, it was confirmed by consulting the last person. Meteorological observatories *were* maintained by the India Meteorological Department at Zanzibar and at Seychelles, showing thereby the importance attached to observations from these places rather than from places further east in the equatorial region. There was hardly any necessity to consider the monsoon in S.E. Asia. Doraiswamy Iyer[2] found much later that there was a great similarity in the summer rain over North Siam and over N.W. India as far as the statistical factors were concerned. The progressive delay in the dates of onset of the monsoon from the east to west did not disturb the earlier workers. The actual mechanism of the S.E. Trades crossing the equator was not definite; though epochs of high pressure in the S. hemisphere appear to have been pictured. For some reason after 1925, the idea of air crossing the equator receded into the background.

In the twenties of this century, the concept of air mass analysis was developed by Bjerknes and his school in Norway, and the idea captured Europe and America. The India Meteorological Department was equally enthusiastic to adopt newer methods of analysis. Roy and Roy (1930) looked into the question of air masses in the monsoon depressions in the Bay of Bengal. Their extent of observations was small. The methods adopted by them followed closely those used in extra-tropical latitudes. These imposed severe limitations on their conclusions. They found three air masses, *viz.*, (1) fresh monsoon air, (2) monsoon air desiccated and deflected by the hills in the N.E. angle of the Bay, or as sometimes designated as old monsoon air, and (3) dry continental air. Normand (1931) said that "the air mass concept was implicit" in the older workers in India. Wagner's[3] paper brought in a definite trend to the later thought. He utilised the upper air data which had considerably increased since Harwood. The picture of the S.W. monsoon was taken to be a vast stationary extra-tropical cyclone or a low pressure area after Bjerknes, *i.e.*, with two air masses. Air from south of the equator did not enter into the picture. Investigations on individual cyclonic storms or depressions in the Indian Seas were undertaken with mostly local data.[1] (Depressions and cyclonic storms are essentially similar and either of the terms will be used here to denote the conditions for both). Doraiswamy Iyer[4] extended the life of many of the depressions of the Bay of Bengal to the Far East with scanty available data. Ramanathan and Ramakrishnan on the one hand and Sur on the other tried to improve on Wagner's ideas with later data.[5] The main idea was that the fresh monsoon air was produced in the N. Indian Ocean.. The southern hemisphere was not generally brought in even for argument, else some space would have been devoted to it. In his contribution to the Indian Science Congress in 1938, Normand apparently kept on to his old view though explicit mention is lacking. Ramanathan and Ramakrishnan in 1938[6] were sceptic about the role of even 'southerly air' in the pre-monsoon cyclonic storms and the text was substantially the same in the reprint of 1943. A study of the monthly mean upper winds could hardly be expected to give clear enough indications of short-period discontinuous incursions of fresh monsoon air from south of the equator. The trajectories that were drawn across wide stretches, based purely on existing observations suffered under the serious disability of not always providing correct clues. Most of the workers tried, somehow, to reduce the tropical depressions into particular cases of extra-tropical depressions of the Norwegian school. It was thought that though at the surface, the structure did not resemble an extra-tropical depression, it should or would do so at a higher level in view of differences in the lapse-rates in the different air masses. Terms like 'upper air fronts' were coined. A scientific worker tries to take into account all the previous work known to him and puts an overall final picture. This is particularly so when mention has been made of the previous work and no statement is made that an alternative picture is being presented. The mere mention of certain terms in a vague way does not prevent the same terms being used by a later worker after giving a *specific* character to the terms or ideas. There should be no possibility of mixing up meanings. It is desirable to give the background of work which led to the ideas.

In 1933-34, I had tried to study the equatorial circulation with the newly started pilot balloon observatories in Br. E. Africa. The observatories were within a few degrees of the equator and were, I thought, suitable for a study of transport of air across the equator. In north-

* Part of the Address at the Physics Sympositum, Indian Science Congress, Patna, Jan. 1948.

ern summer, large southerly components could be found up to about 1·5 to 2·0 kms. at these places. The data from the Malayan Peninsula and from the Far East were also used. Unfortunately other duties prevented me from following up the ideas. While forecasting at Karachi (1938-42), I was distressed like most novices, at the large mass of disjointed facts apart from a few well-known ones. Among them were: "A western disturbance would, often, have passed away over Iraq according to prevalent ideas. But yet, Bahrein continued to record southeasterly or southerly winds and Bushire continued to record low pressure values and the value used to be very often corrected. During the summer, in the Persian Gulf region, instead of the usual "Col" pattern, a hexagonal pattern with three low pressure areas alternating with three high pressure areas existed almost daily. Simple ideas of axes could not be applied. The hexagonal pattern and the stationary type of the S.W. monsoon were apparently connected. There was hardly any detectable disturbance over Iraq; on the evening of 16h February 1939, the upper winds at about 2·0 kms. were 180° apart at Bahrein and Sharjah. Later a ship reported a southerly wind off Oman. The subsequent fortnight of bad weather with its air accidents were difficult to explain cogently. B. N. Banerji had given the idea of a secondary western disturbance. The fact that every western disturbance had to be divided up into a series of separate circulations, each of which could be supposed to have its own identity and evolution, was not on record. Fresh problems were posed when the observations from Iraq were cut off in 1940 due to disturbances there. By an analytical method of mixing up of cause and effect, the criteria for the production of dust-rising winds were determined. Sen's vortex method of weather forecasting appeared after 1942.[1] After I came to Poona in May 1942, the ideas that were represented on the charts did not agree with what I had gathered at Karachi for the same region. The security reasons prevented access to work elsewhere. Deppermann's pre-war work was available only at the end of 1946. Pendall's charts came slowly in batches after August 1943. Apart from this, observations from familiar places like Burma and Sumatra and from the ships were cut off and those from Russian Turkestan, new to us, obtained. In between Russian Turkestan and the frontiers of India the area was unrepresented. The maximum use had to be made of the data without waiting for the 'collection of statistics' or 'climatology'. *Ad hoc* methods were not in place. Fresh data would trickle in at any time and newer demands were made by the weather clients. It was very necessary to formulate some method of tackling the problem, and in a colloquium at Poona in January 1943, the "Basis of Tropical Meteorology" was given.[7]

The drawing of isobars or other isopleths in the tropics was the first problem. They had to belong to a non-intersecting family of curves. The pressure and wind at each place gave three quantities which went to solve the equations determining the members of the family. This advantage could not be sacrificed on the plea of uncertainty of observations or of their significance. Rules were formulated so that fairly reproducible curves could be drawn.

In the tropics, the disturbances are mostly diffuse. They have to be split up into individual circulations and followed step by step. The principle of minimum action was applied to the motion of depressions, which should have a preference to cross coast near the river deltas, valleys and to move in between the corridors of two high pressure areas. The idea of latitudinal convergence was applied to both streams and disturbances. A depression that had an *apparent* equator-ward travel and showed a *deepening* was definitely taken as composed of two depressions. The main depression moved as usual, polewards and a secondary depression had developed on the more equatorial side. The western disturbances and the typhoons that crossed over into the Indian area furnished the evidence for this concept.

The effect of a limited obstruction like a mountain or a high pressure ridge in the path of a depression of the same or bigger order of dimension was next considered. A secondary depression can often be induced on the other side of the obstruction even though the original one was deflected away polewards.

The principle of 'confusion or mixing up of cause and effect' was necessary in a continuous and uncontrollable process or series of experiments. The principle of superposition follows logically for a resynthesis of meteorological phenomena.

While it is hardly possible to write down the concrete steps in any but extremely general steps, yet the definite method of approach was a step forward. Obviously, any theory so formulated must lead to further verifiable results without an overloading of *ad hoc* assumptions. There must be an essential rational structure in tropical meteorology. The ideas were verified in a few typical cases. When they were found correct, newer logical consequences were deduced for further verification and in turn for further deductions. Due to inherent observational difficulties, it was realised that not all stages of argument could be verified. If, however, there was a definite contradiction in the course of the work, all assumptions were re-examined and suitably modified. The starting point was the ideas actually prevalent. This method saved time and gave the much needed results. When draft "Notes on Forecasting Weather Over India and the Neighbourhood" had to be written up in January 1943, the method allowed me to write up the book continuously (in a few weeks), as a series of connected facts. Any other method would have involved formidable work and inordinate delay. Soon after the observations from the Indian Ocean were charted (May 1943), the essentials of tropical depressions and of monsoon could be grasped.

The surface gradients of the measured elements in the tropics are small compared with their corresponding values in the temperate zones. If an attempt at air mass analysis has to be made distinctly and unmistakably, the tracing in space and time has to be from a far enough region from an actual depression. The sequence of meteorological phenomena is an important guide in following the air streams.

Mauritius used to send telegrams about cyclo-

nic storms in the S.W. Indian Ocean in the non-monsoon months up to the end of 1942. The concurrent weather over India was noted. The old ships' logs near the equator were also consulted. The weather near the equator was found to be significantly related a few days before the detection of formation of cyclonic storms on either side of the equator. Fresh monsoon air crossed the equator only at intervals and under only specified conditions. A definite time sequence was found and could be used for medium range weather forecasting.

In my experience the heat waves at Agra (1935-37) and at Karachi (1938-42) were followed by unsettled weather in the Bay of Bengal or in the Arabian Sea respectively. The time sequence was detectable.

Roy and Roy's idea of "deflected and desiccated monsoon air" was highly localised in space and time. It could not be used for a monsoon depression in the N.E. Arabian Sea. It could not be applied to even the depressions in the Bay of Bengal in the non-monsoon months. Often, the sequence of weather did not permit the time lag required for the monsoon air to get deflected. The potential wet bulb temperature of this 'deflected' air was greater than that of the fresh monsoon air so that the idea of desiccation is invalid. The application of this deflected and desiccated air, elsewhere in the tropics, was out of question. Sen and Puri's observations were confined practically to India and Burma. Little attempt was made to trace the air masses even by implication to high pressure areas. Deppermann found, sometimes, on the N.E. side of the typhoons a warm sector near the Philippines. His background of analysis is similar to that employed for extra-tropical depressions. My method of detection of this third air mass was based on a study of carefully drawn isobars, streamlines and on the sequence of weather. It came from the east and its temperature and humidity changed considerably with season and locality.

The monsoon depression and tropical cyclonic storms with a westward travel had the same structure and involved the incursion of three and only three air masses: (1) Fresh monsoon air or Equatorial Maritime air (Em) from the other side of the equator; (2) Far Eastern Transitional air (Tr) and (3) Dry Continental air (Tc and occasional Pc). The chief features of the three air masses are:

*Equatorial Maritime Air* (Em).—During the S.W. monsoon and in the pre- and post-monsoon months, fresh maritime air crosses the equator from the south at intervals depending on other specific meteorological conditions. The actual time taken to cross the equator is very small. There is a good interval of a few days before the next crossing can take place at or near the same locality. The word 'pulse' of monsoon was employed to indicate the discontinuous and short-period crossing of air from the southern hemisphere. The character of the air mass undergoes considerable change during its travel. It starts from one of the high pressure cells in the southern hemisphere as almost dry continental air (Tc). In its westward travel, it gradually picks up moisture and additions of dry air from further south. Later, due to its moisture content, it can be recognised as giving rise to shallow low pressure areas. Its vertical height is not more than 2 kms. It moves in an almost W. or W.N.W.-ly direction. The air at this stage corresponds to the Far Eastern Transitional or Mixed air (Tr) described later. As there is an equator-ward component in the motion of the shallow low pressure area, the air cannot be made easily unstable. It picks up considerable amount of moisture and temperature when moving over large water surfaces in the tropics. Being southern winter, the moisture content would be large only in the lower layers. Mid-air temperature inversions would be found at about 1·5 kms. As the shallow low pressure area or 'pulse' aproaches the equator, the moisture content increases appreciably. When just about to cross and certainly after crossing the equator, the air would have accumulated a large amount of energy and the temperature inversion disappears. The equator acts as a sort of selective barrier which is not impassable. After crossing the equator and moving northwards, the air undergoes convergence due to pole-ward travel. *The air at this stage is Em.* It can be made easily unstable. Thunderstorms occur all along its path and the weather over the sea would be squally. The diurnal variation of temperature in its mass is small, hardly 2° to 3° F. The sea-level temperature is just under 80° F. In its northward travel, due to latitudinal convergence and due to its passing over the sea the vertical thickness of moisture increases and the energy is easily releasable. It acts as a 'source' among the tropical air masses.

*Far Eastern Transitional or Mixed Air* (Tr).—This is a mixture of Tropical Maritime air (Tm) and Tropical Continental air (Tc) in varying proportions depending on the locality and season. In the Pacific Ocean, there may be even a mixture of Em. In winter, over land area, there may also be Polar Continental air (Pc). The air comes to India from the same side of the equator as the depression; the ultimate origin of Tm is the high pressure area over the N. Pacific Ocean; and the high over N. Asia supplies Tc and in winter even some Pc. Tr flows along the 'N.E. Trades' in winter. In summer, it flows along the displaced 'N.E. Trades', displaced because of the vast low prssure area over Asia. Part of the air has an equator-ward travel and tends to develop stability in its mass and, as mentioned by Braak long ago, mid-air temperature inversions. Once the temperature inversion has developed, it is not sensibly affected by the slow drifting of air northwards round the anticyclonic cells. If the mid-air inversion is wiped out by rapid latitudinal convergence, bad weather and very heavy rain can result. Ordinarily it does not release energy, though it is hotter than Em in summer, both as regards the dry and wet bulb potential temperatures; and it passes very near the temperature and pressure equators. In the hills of N.E. India, it may produce some weather due to orography and due to any convergence. The word 'Transitional' is apt as the air undergoes all the stages in the transformation from Tc to Em in its travel from one of the high pressure cells upto its crossing the equator to the other side.

*Tropical Land Air or Continental Air* (Tc).—For India, it has mostly a land origin from lands in W. Asia. It can be described as Tc with an occasional mixture of Pc. Its humidity is small and it shows a large diurnal variation of temperature on the ground. It brings in unusually hot or unusually cold days over the regions where it passes. For depressions in E. Bay of Bengal or E. Arabian Sea it would be mixed with Tm or Tcm. It is unnecessary to have a separate classification: Equatorial Continental air (Ec), for hot dry air.

With an extensive weather chart, the various air masses can be separated and studied. In the case of the S. hemisphere, an obvious interchange of words 'north to south' and *vice versa* in the above has to be carried out. The ideas are applicable to any part of the tropics.

An important point has to be stressed. The three air streams may be in juxtaposition very near the tropical depression. But earlier to the formation of, and further away from the location of the depression, between every two infeeding streams there is a sort of stagnant air which can at best be described as 'mixed'. The larger circulation due to the tropical depressions may affect the 'mixed' air. If the latter is moist enough, in the 'larger' field of circulation of the depression there would be precipitation whenever there is convergence due to latitude or otherwise. It is possible to mistake this 'mixed' air as the main moist stream of the depression and follow it. One of the most important areas where the 'mixed' air occurs near India is in Central and East Arabian Sea. The West Arabian Sea has Tc from Africa. Before the formation of a monsoon depression at the head of the Bay of Bengal, the track of thunderstorms is from the S.E. Madras to Orissa coast. But with the formation of a monsoon depression in the N.W. angle of the Bay of Bengal, places like Poona get continuous rain. The west coast may get rain as far north as Dahanu, north of Bombay. Within a very short time after the Bay depression has crossed coast, sometimes as short as half an hour, the rain stops at Poona and often even along the N. Konkan coast. Rain along the west coast of India and the rain at Poona are *not followed*, after a definite number of days by a depression at the head of the Bay of Bengal. It appears that the rain along the west coast and at Poona must be due to convergence in the 'mixed' air due to the larger circulation of the Bay depression and perhaps orography. The rain near Gulbarga, Bangalore or Kodaikanal when there are depressions at corresponding latitudes in the Bay must have similar explanation. Pisharoty[8] found the distance between two convergent areas due to change in latitude of an air stream applying Holmboe's theory. The distance from Poona to the head of the Bay of Bengal was of the right order. If the 'mixed' air in the Arabian Sea is not moist enough or if the amount of convergence is insufficient, rain may not fall along the west coast with a depression at the head of the Bay. It is easy to explain the temperature structure of the air stream on the rainy days and the simultaneous onset of the monsoon rain throughout the west coast. The type of rain associated with a depression in the N.E. angle of the Arabian Sea has much more of a creep along the west coast. The other 'mixed' air which needs to be taken into account is the Tr which has approached the equator, which is deflected back due to some reason and which undergoes sufficient latitudinal convergence. Its property would be very similar to Em. A plea may be put forward that the bent-back Tr from the equatorial regions or the 'mixed' air from the Arabian Sea may sometimes be the monsoon feeds of a tropical depression. The over-all sequence of weather phenomena and the reaction of weather in the northern tropics when there is a tropical depression south of the equator in the same longitudinal sector are strong arguments against the plea.

It was found that after a tropical depression recurved eastwards, it had only two sectors and had only two air masses.[9] The air masses could be designated as Tm or Tcm and Tc with an occasional mixture of Pc. The depression resembled the extra-tropical ones. When Em was absent, the depression had an eastward motion. A rigorous convention can be established that a depression is strictly tropical when all the three air masses including Em are present and has, therefore, a westward movement. The depression is to all purposes extra-tropical in structure when only two air masses are involved and has an eastward tendency of motion. Before the actual change of directions takes place the previous momentum of the depression as an entity should be taken into account. Nearer the equator, after a depression has recurved eastwards, it may again get an infeed of Em and once more move westwards. This occurs sometimes and makes a depression change its course unexpectedly from some N.E.-ly direction to some N.W.-ly direction in the Indian area.

Low pressure areas or diffuse disturbances, however, travel in either direction according to the motion of the 6 km. winds in the 'source' sector.

The western disturbance could be split up into simpler circulations or secondary low pressure areas. Each of these had a distinct and evolution.[10] Each of them moved in a well-ordered way almost E.N.E.-wards. The weather at a place was a resultant of the effects of the simple lows. The seasonal low pressure area in winter is south of the equator and modifies the secondary lows of the western disturbance particularly in the more southerly latitudes of the northern hemisphere. The strength of the westerly winds at higher levels decreases as the equator is approached. Each secondary low pressure area of the western disturbance travels slower and extends vertically to a lesser height than its immediate northern primary. Outside the coast of the Persian Gulf and Oman, there were hardly any series of observations. This and the slower travel of the more southerly secondary depressions gave a faulty impression of S.E.-ly travel of western disturbances in the Gulf. The detailed analysis is consistent with known facts.

During the course of the work, a very fundamental result was found regarding the weather in one hemisphere when there is simultaneously a tropical depression in the other in a small sector of longitude. It was found that two tropical depressions, both moving in a westward direction, could not for long coexist on either side of the equator when the longitudinal sepa-

ration was small, about 10°. In winter, the existence of a similar tropical depression in the S. Indian Ocean gave dry weather over N.W. and Central India even if western disturbances passed over India. During the S.W. monsoon, a 'break' occurs if a monsoon 'pulse' does not cross into the Indian region and moves away westwards or if no 'pulse' appears south of the equator. The first would happen if there be a tropical depression in the S. Indian Ocean. The southern depression may give rain in the extreme south Peninsula within about 12° of the equator. It follows that whatever be the season, outside 10° or 12° of the equator, the weather over a greater portion of India would be generally dry if there be a tropical depression in the S. Indian Ocean. Though tentative dynamical reasons were given to account for the effects,[10] the facts have been verified. In general it follows that the weather would mostly be dry in a latitudinal belt between 12° and 30° of the equator and a longitudinal sector of

(b) one of the tropical depressions may fill up and the other may continue on its westward journey;

(c) one of the tropical depressions may recurve under the influence of an extra-tropical depression and the other tropical depression may continue its westward journey;

(d) Both the tropical depressions may recurve after they have moved away from the equator under the influence of extra-tropical depressions or their secondaries.

The strength of the easterlies at 6 kms. near the equator is smaller than the strength of the westerlies away from the equator. Under similar conditions, an extra-tropical depression moves much faster than a tropical depression. As a rule, the rate of latitudinal shift is also similar. Hence, a recurved tropical depression must normally be more severe than it was before recurvature. If, however, under category

**EVOLUTION OF A TROPICAL CYCLONIC STORM**
*(Idealised diagram of air mass partitions on successive days.)*

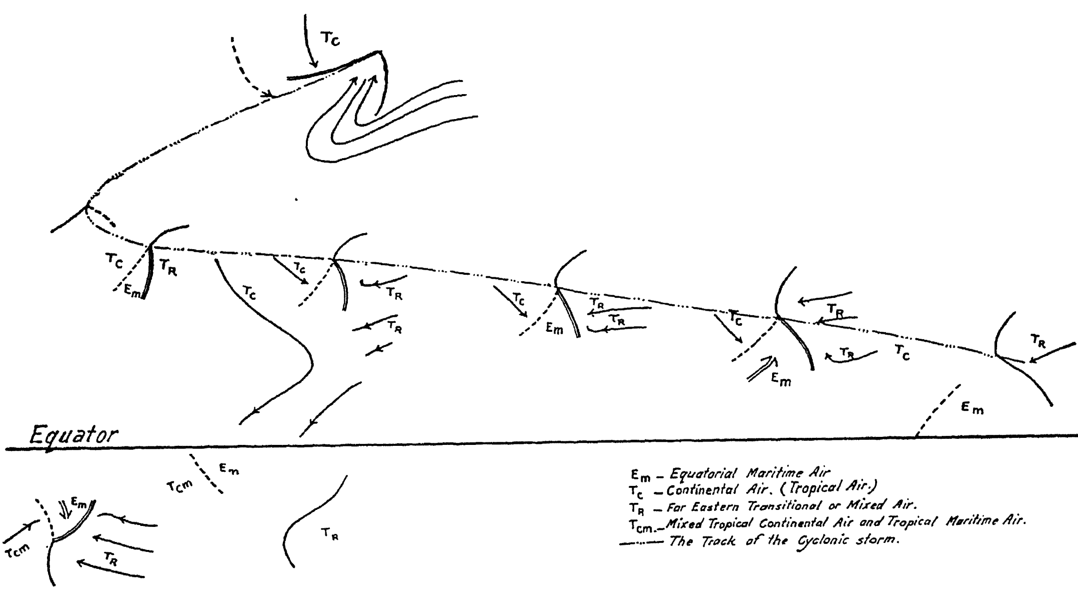



FIG. 1

15° to 20°, whenever there is a tropical depression in the other hemisphere moving in a westward direction. This rule can be used with benefit over the Pacific Ocean and over Australia. As a counterpart, when the 'Trades' fed into an extra-tropical depression, the latter would be more active than usual. A recurved tropical cyclonic storm is an extreme case of this.[10]

As two tropical depressions cannot co-exist for long on either side of the equator within a small longitudinal sector, four distinct possibilities can occur:

(a) Both the tropical depressions may fill up, particulary if they are fairly near the equator;

(c) there is a tropical depression on the other side of the equator, the recurved tropical depression does not get to be severe soon after recurvature. The problem is similar to a western disturbance with a tropical depression on the other side of the equator. After the separation between the recurved depression and the westward moving tropical depression has become large enough in longitude, the former, if it still exists, has a chance of getting severe (see idealised figure).

More popular conclusions would be the partial explanations of "Why is a major portion of India dry in winter?", "Why is Australia drier than India?" and of the distribution of arid zones on either side of the equator. The deve-

lopment of high pressure belts, during the winter, may also be explained.

The application to medium-long range forecasting on a synoptic basis is implicit in the above. The most important air mass Em was traced from the northern side of the high pressure area in S. America. Its travel south of the equator to the north of the seasonal high pressure belt was modified by several meteorological conditions till it finally moved into the N. Indian Ocean. A good climatic chart showed what the factors would be and these provided the long-sought for physical explanation of centres of action determined statistically by Walker. To further verify the ideas, the analogous case of the southern monsoon was traced from the southern side of the winter high pressure area over N. America and the modifying factors found. Rain in N.W. India being adversely affected by southern depression, it should be negatively correlated with the southern monsoon and hence with the high pressure on the south-west side of the winter N. American high after a definite time lag. With data extending over 75 years, the value of the correlation coefficient was $-0 \cdot 38$: a significant value.[11] This factor had not been used earlier and hence was a critical one. The role of Tc and of Tr in medium-range forecasting was also determined. The method of analysis of a western disturbance and the differential rates of travel and evolution of the secondaries, when Tr fed into them or away from them, were directly usable.

The question of 'heat' and 'frontal' thunderstorms was tackled. In the case of 'frontal' thunderstorms, there is an appreciable fall in the wet bulb temperature. With the help of analysed western disturbances, where the secondary travels slower and extends to a lesser vertical height than its northern primary, a simple explanation of the fall in the wet bulb temperature could be given without invoking the descent of air from 4 to 6 kms. Heat thunderstorms were looked into. Taking account of the daily variations in the high pressure belts in upper air at about 2 kms. on either side of the equator, the thunderstorms that occur on the pole-ward side of the belt are of 'frontal' type and those that occur in the equatorial side of 'heat' type.[12] Tornadoes that sometimes accompany 'frontal' thunderstorms cannot, therefore, occur in the tropics.

The application of the above methods have been helpful in understanding tropical weather in a rational way, and many problems can be explained satisfactorily.

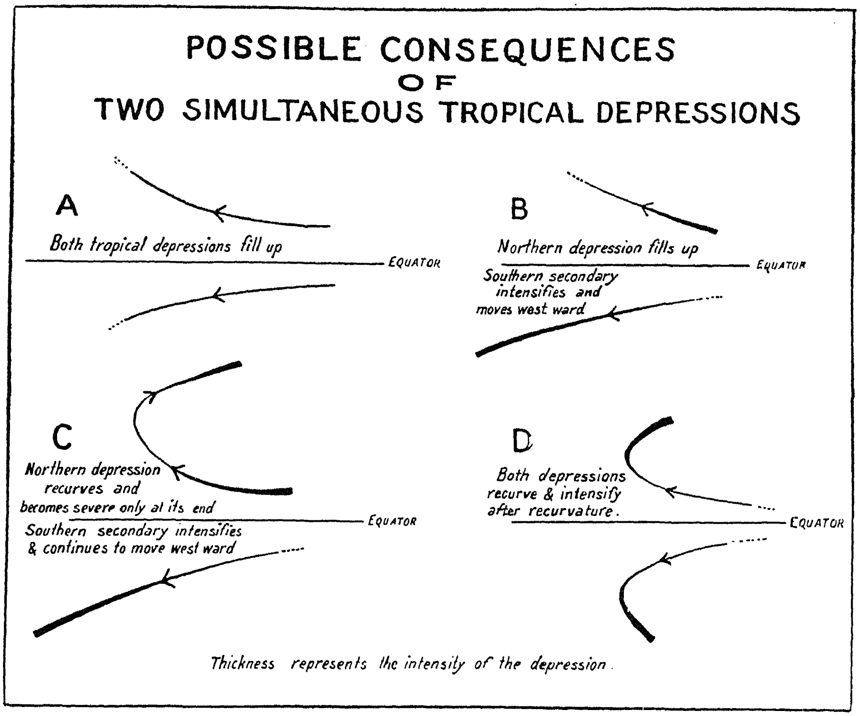



FIG. 2

1. The references are found in *Curr. Sci.*, 1947, **16**, 177, and Hemraj, *The Imperial Gazetteer of India*, 1907, **1**, 3. Doraiswamy Iyer, see below. 2. Doraiswamy Iyer, 'Rainfall in Siam, *Sci.' Notes Ind. Met. Dept.*, 1931, **4**, 69. 3. Wagner, *Gerl. Beitr. z. Geophys.*, 1931, **30**, 196. 4. Doraiswamy Iyer, *Mem. Ind. Met. Dept.*, **26**, 93. 5. Ramanathan and Ramakrishnan., *Mem. Ind. Met. Dept.*, 1932, **26**, **13** and Sur *ibid.* 37. 6. Ramanathan and Ramakrishnan, *ibid.*, 1938, 189 (reprinted text, 1943), 7. Malurkar, *Proc. Ind. Acad., Sci., Bangalore.*, 1947, **25**, 297. 8 Pisharoty, announced in *Symposium Nat. Inst. Sci.* (*India*), Sept 1946. 9. Malurkar, *Curr. Sci.*, 1947. **16**, **14**. 10. Malurkar., *ibid.*, **139**. 11. Malurkar, *ibid.*, 77. 12. Malurkar, "Winter Rain in the United Provinces and Norwesters in Bengal;" Malurkar, "Mechanisms of Thunderstorms in the Tropics" (MSS. unprinted yet).

*Note.*—The cost of printing this article has been met from a generous grant received from the National Institute of Sciences, India.

# LETTERS TO THE EDITOR



## DIRECT VOLUMETRIC DETERMINATION OF CALCIUM IN PRESENCE OF MAGNESIUM

THE determination of small amounts of Calcium in presence of large amounts of magnesium is a problem of considerable difficulty. The oxalate method for calcium yields a precipitate contaminated with magnesium oxalate and special procedures have, therefore, to be employed. Kuchment and Gengrinovich[1] recently introduced a method of direct titration of calcium with sodium oxalate in presence of cacotheline and ferrous ions which yielded a violent end-point. These authors claimed that calcium could be rapidly determined (1-2 minutes) in presence of magnesium, at least five times the quantity of calcium, in acetic acid medium with an accuracy of $\pm 0 \cdot 15$ to $\pm 0 \cdot 67$ per cent., and a higher degree of accuracy using a blank correction. The colour of the end-point is stated to be due to the reduction of cacotheline by the ferrous ions when oxalate ions are present to react with the ferric ions.

In an investigation dealing with the recovery of magnesia from dolomite, a rapid method for the determination of progressively diminishing quantities of lime in presence of relatively large amounts of magnesium was required and at first sight, the above method appeared to be promising. On investigation, however, it was found that there were several complicating factors and the results of Kuchment and Gengrinovich[1] were not fully corroborated.

The present author's observations were as follows:—

(a) The end-point in a neutral solution was blue and only in acid solutions, violet;
(b) the colour as well as the stability at the end-point depends on acidity the increase of which reduced the stability;
(c) Acidity was also a factor determining the value of the blank on cacotheline and ferrous ions;
(d) the reactions leading to the colour of the end-point are slow so that an appreciable interval exists between the addition of oxalate and full development of colour; and
(e) it was generally observed that the end-point was hardly stable for one minute and although the time lag was sufficient for noting it, a greater stability would be a desideratum for a good analytical method.

In actual determinations of calcium it was found that the acid concentration (acetic acid) is very important. If neutral the end-point is blue, if weakly acidic the colour is violet, but the end-point is not clear. With 0·5 c.c. of acetic acid in a volume of 50 c.c. good end-points were obtained for amounts of calcium ranging from 100 to 60 mg. At the same acid concentration, with smaller amounts of calcium the end-points were obtained too soon and the errors were very high; when the acid concentration was increased to 1 c.c. per 50 c.c., similar difficulties were experienced in all cases.

With an acidity of 1·0 c.c. of acetic acid per 50 c.c. of total volume of a mixture of calcium and magnesium, good results were obtained only up to a magnesia content twice that of lime.

The above experiments were carried out with a B.D.H. sample of cacotheline for "Spot Tests" and neutral solutions of calcium and magnesium chlorides. A neutral aqueous solution of ferrous ammonium sulphate was used to supply ferrous ions.

Fuller details will be published elsewhere. The author wishes to thank Dr. K. Neelakantam for his kind interest in the work.

Dept. of Chemical Technology,
Andhra University,
*March* 9, 1948. A. VENKATESWARLU.

1. Kuchment and Gengrinovich, *Chem. Abs.*, 1946, 1412; *Analyst*, 1947, **72**, 492.

## FAR ULTRA-VIOLET EMISSION BANDS OF PHOSPHORUS

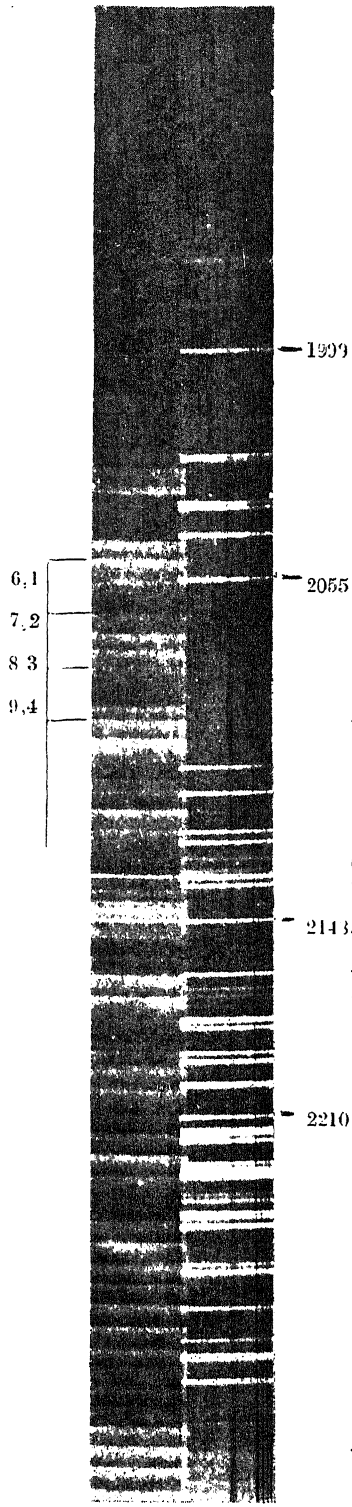
OUR knowledge of the extensive ultra-violet band system ($^1\Sigma^+_u \rightarrow {}^1\Sigma^+_g$) of the $P_2$ molecule and its vibrational structure is due to Jakowlewa[1] who studied the system in absorption. Herzberg[2] investigated the same system in emission but reported only bands involving the ground state levels from $v'' = 4$ to $v'' = 32$. No bands were recorded arising from levels $v''$ less than 4.

Excitation of the band spectrum using a High Frequency Oscillatory discharge through heated phosphorus vapour with external electrodes gave a fairly intense system down to $\lambda$ 1940 (cf. Fig. A). About 50 bands are newly recorded *in emission* having the ground state levels $v''=0$ to 4. The classification of these and their wave-length data are given in the following table.

TABLE I

| Wave-length | Int. | Classification ($v'$, $v''$) | Wave-length | Int. | Classification ($v'$, $v''$) |
|---|---|---|---|---|---|
| 1949·5 .. | 0 | 10,0 | 2108·4 | 1 | 3 1 |
| 62·9* .. | 0 | 11,1 | 11·5* | 2 | 8,4 |
| 83·3 .. | 0 | 8,0 | 16·4 | 4 | 6,3 |
| 93·0* .. | 1 | 11,2 | 22·5 | 2 | 4 2 |
| 2000·4 .. | 1 | 7 0 | 35·1 | 0 | 0.0 |
| 09·8* .. | 1 | 10.2 | 39·9* | 2 | 10,6 |
| 17·9 .. | 1 | 6,0 | 43·3 | 2 | 3 2 |
| 24·3 .. | 1 | 11 3 | 45 5* | 3 | 8,5 |
| 27·7* .. | 1 | 9,2 | 51·5 | 0 | 1,1 |
| 32·2 .. | 1 | 7,1 | 52·5* | 1 | 6,4 |
| 33·1* .. | 2 | | 53·5* | 1 | 11,7 |
| 42·1 .. | 1 | 10,3 | 59·4* | 2 | |
| 45·6* .. | 2 | 8,2 | 60·9* | ? | 9,6 |
| 50·2 . | 1 | 6,1 | 64·0 | 0 | 2,2 |
| 55·1 .. | 1 | 4,0 | 79·1 | 1 | 3,3 |
| 64·7 .. | 2 | 7,2 | 86·6 | 2 | 1,2 |
| 69·1 .. | 2 | 5,1 | 88·8 | 3 | 6,5 |
| 73·9 .. | 2 | 3,0 | 93·3 | 2 | 4,4 |
| 78·3* .. | 1 | 8,3 | 95·3* | 3 | 9,7 |
| 88·4 .. | 2 | 4,1 | 2200·6 | 4 | 2,3 |
| 92·1* .. | 2 | 9,4 | 09·3 | 2 | 0,2 |
| 97·1 .. | 3 | 7,3 | 15·7* | 4 | 3,4 |

Band heads observed only in emission; not obtained by Jakowlewa in absorption.




$P_2$ bands and Cu Arc comparison

In addition to the above system, Herzberg mentions another brief system consisting of five

bands from λ 3970 to λ 4230, ascribed to the P. molecule. These bands are not observed on our plates.

Andhra University,
Waltair, K. SREERAMAMURTY.
*March* 19, 1948.

1. Jakowlewa, *Zeits. f. Phys.*, 1931, **69**, 548. 2. Herzberg, *Ann. der Phys.*, 1932, **15**, 677.

## WINTER RAIN IN SOUTH INDIA

THE weather in South India in the winter period of mid-January to March is characterised by occasional outbreaks of thunder rain, the onset of which is rather sudden and occurs in the early part of the day. These spells of rain are of the N.E. monsoon type[1] and do not disclose themselves sufficiently in advance on the usual synoptic charts. Tephigrams of Madras, analysed in the manner recently suggested by Schell,[2] have been found by the author[3] to be of considerable forecasting value; but their usefulness is confined to the forecasting of the *local* weather only and that too within a few hours of the atmospheric sounding. Experience of the author at Madras has shown that Isentropic Charts give useful and reliable clues to anticipating spells of such rain in South India well in advance. A typical instance of such usefulness of isentropic charts is reported here.

There was a spell of thunderstorm rain in South India from the midnight of the 14th March 1946 till the evening of the 18th. This followed a protracted period of absolutely dry weather. Widespread and locally heavy rain occurred in the Peninsula south of the latitude of Madras (and also in Ceylon) on the 15th and the 16th. The area of precipitation almost clear everywhere even as late as on the evening of the 14th. But by the morning of the next day, the skies in the S.E. Madras area were nearly overcast with Cb, Fb, As and Ns. There were no significant pressure changes till the morning of the 15th. The upper winds were more or less normal throughout the above period.

The isentropic chart of the 13th evening at the 310° A level is shown in Fig. 1. The station model adopted for representing the isentropic data is as follows:

(X) Actual mixing-ratio ○ pressure (P)
($X_c$) Saturation mixing-ratio condensation Pressure ($P_c$)

Isobars are drawn on this chart at intervals of 50 mb. as continuous lines and isohygrics at intervals of 2 gm./kgm. as broken lines. The contour of the isentropic chart, as delineated by the isobars, shows the existence of an isentropic "hill" with its apex over the Comorin area. The earlier isentropic charts showed a gradual concentration of the seasonal moist tongue in the South Bay. It advected westwards and invaded the whole of S.E. Madras by the evening of the 13th. The atmospheric cross-sections, not shown here, revealed that the moist tongue extended vertically up to a height of 15,000 ft. The winds on the isentropic chart in Fig. 1 have a considerable cross-isobar component.

The axis of the moist tongue lies between Madras and Colombo, which are thus on its opposite peripheries. Even at these places, we find the "lift" required for condensation to be about 100 mb., as shown by the intervals between *P* and *Pc*. The lift would, therefore, be much less near the axis of the moist tongue and may well have been under 50 mb. there. The westward advection of the moist tongue would result in its moving up-slope on the

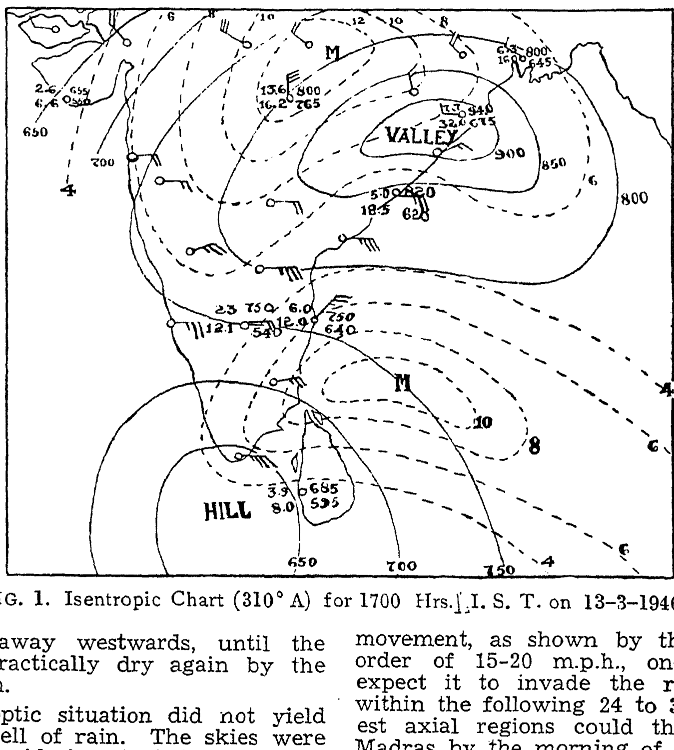
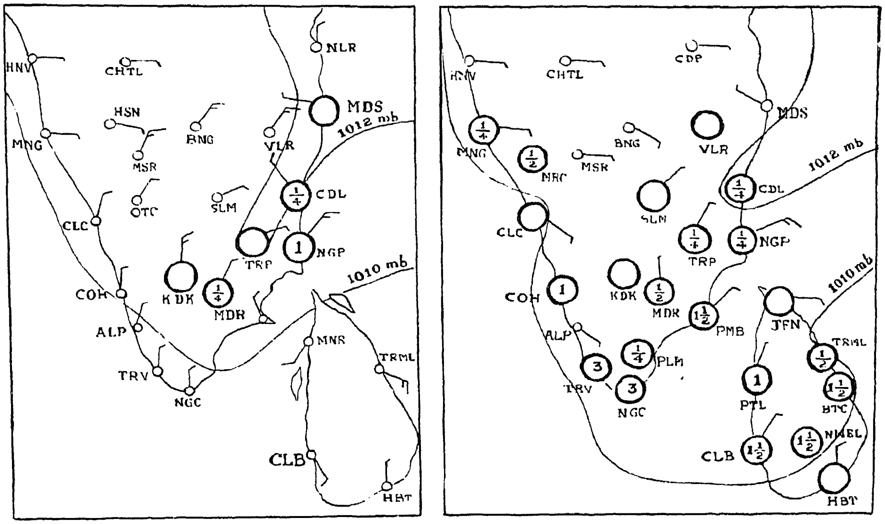



FIG. 1. Isentropic Chart (310° A) for 1700 Hrs. I. S. T. on 13-3-1946.

gradually moved away westwards, until the weather became practically dry again by the evening of the 18th.

The earlier synoptic situation did not yield any clue to this spell of rain. The skies were isentropic hill. Considering that its speed of movement, as shown by the winds, is of the order of 15-20 m.p.h., one could reasonably expect it to invade the rest of South India within the following 24 to 36 hours. Its moistest axial regions could then come over S.E. Madras by the morning of the 15th. A subsequent westward movement of the moist tongue




Date: 15-3-1 946 Date: 16-3-1946

FIG. 2. Weather Map for 0800 Hrs. I. S. T.

could be expected to result in the westward extension of the area of precipitation. The isentropic chart thus shows that conditions were sufficiently favourable for the occurrence of precipitation over S.E. Madras by the morning of the 15th.

The weather subsequently realised on the 15th and 16th is shown in Fig. 2. All places where any sizable precipitation occurred are indicated in this figure by encircling them. The circles around places where the fall of rain was less than ¼″ are left blank. Where the amount exceeded ¼″, the rounded amounts are charted inside the circle. The surface winds and the isobars are also shown on this chart. These charts fully bear out the arguments set forth in the above paragraphs. It will be noticed that the areas where the heaviest fall of rain occurred by the morning of the 16th are in the extreme south of the Peninsula with lighter falls of rain to the north and south. This is because the steepest up-slope movement as well as the highest concentration of moisture in the moist tongue obtained in that area. The greater intensity of the precipitation in the southern as compared with the northern parts of the moist tongue is due to the existence of the isentropic hill over the Comorin area.

Details are being published elsewhere.

The author's thanks are due to Mr. B. N. Sreenivasaiah, Meteorologist, Madras, for his kind interest in the work.

Meteorological Office,
St. Thomas' Mount,
Madras,
February 15, 1948. D. VENKATESWARA RAO.

---

1. Sreenivasaiah. B. N., 1946, *Technical Note No.* **23**, *India Meteorological Department*. 2. Schell, I. I., *Bull., Amer. Met. Soc.*, 1946, **27**, **164**. Venkateswara Rao, D., "Precipitation Index and Subsequent Rainfall at Madras", Under publication as a *Sci. Note, Ind. Met. Dept*.

## BAND SPECTRUM OF THALLIUM IODIDE

EXCITING the vapour of Thallium Iodide by a low power high frequency oscillator, a characteristic band spectrum ascribed to the diatomic molecule, Thallium Iodide, was obtained extending from λ 5300 to λ 3750, the wavelength region between the two components $^2P - ^2S$ of the Thallium arc. The bands are generally headless but some of them are red degraded. Over a wide range, they occur in well-separated groups, each consisting of about 4 or 5 equi-spaced components with an interval of about 28 wave-number units. Each group presents a maximum and then a gradual falling off in intensity, indicating a clear sequence structure. By comparison with the corresponding spectra of the other related halide molecules (In, Hg, etc.), these bands are interpreted as forming two overlapping systems due to the transitions $^3O^+ \to {}^1\Sigma^+$ and $^3I \to {}^1\Sigma^+$; the vibrational frequency $\omega''_e$ of the common ground state is derived to be approximately 122 cm.$^{-1}$, the anharmonic constant being negligibly small. The frequency $\omega'_e$ corresponding to the state of $^3O^+$ is approximately 94 cm.$^{-1}$

A third brief system is also obtained between λ 3680-λ 3600 consisting of three or perhaps four continuous patches superposed by distinct sequences of bands separated by the same wave-number interval of about 28 units. The lower state of this system is considered to be the same as that of the above systems.

Details of the analysis will be published elsewhere.

Andhra University,
Waltair,
March 31, 1948.

P. TIRUVENGANNA RAO.
K. R. RAO.

## MORNING THUNDERSTORMS AT COCHIN IN THE PRE-MONSOON SEASON

As pointed out by Sreenivasiah,[1] there is a remarkable concentration of rain and thunderstorm in the morning and forenoon hours at Madras in the early part of the withdrawing S.W. monsoon season. It is also the author's experience that such morning thunderstorms are very frequent on the west coast of the Peninsula, for example at Cochin, in the pre-monsoon months. In both cases, cumulonimbus clouds, as a rule, form over the sea off the coast and advance towards the coast later with the winds prevailing aloft. The nature of the "trigger", which releases the energy from the conditionally unstable atmosphere in such cases is still obscure. The notes kept by the author while at Cochin during the pre-monsoon months in the year 1944, when a number of radar observations were available, appear to throw some light on the problem.

All the data available at Cochin relating to the pre-monsoon morning thunderstorms are shown in Table I below. The place from where the radar observations were made was Eddappilli, about 10 miles to the N.E. of Cochin. The times given under column 2 are those of location of the active thunderstorms by the radar. The ranges of the storm centres from the coast and their bearings with respect to the place of observation are given in the next two columns. The data in the last two columns are the observations made at 09.00 hrs. I.S.T. at the Cochin Observatory.[2] Though the wind on the 20th at the Observatory was calm at 09.00 hrs., it was N.E. at the pibal station at Willingdon Island, which is a little to the east of Cochin. Also, at 09.00 hrs., moderate continuous rain was in progress at the Observatory. The current weather observations made at the pibal station also showed that the land breeze persisted from about 02.00 hrs. to 12.00 hrs. on all the days; and there was no shift in the wind direction until the thunderclouds came overhead.

TABLE I

| Date | Time in I.S.T. | Range in miles | Bearing in deg. | Surface wind | Minimum temp. in °F. |
|---|---|---|---|---|---|
| 9-5-1944 .. | 1115 | 43-46 | 255 | ENE | 77 |
| 11-5-1944 .. | 0601 | 25-35 | 230 | ENE | 74 |
| 20-5-1944 .. | 0858 | 8-11 | 227 | Calm | 75 |
| 29-5-1944 .. | 1125 | 42-52 | 305 | SE | 77 |
| 29-5-1944 .. | 1235 | 35-45 | 307 | SE | 77 |

It is seen from the above table that the bearing of the centre of the thunderstorm on the various days is just opposite to the direction of the surface wind at the time. This is significant because the surface wind on all those occasions was the relatively cool land breeze, which generally extends vertically up to 2,000-3,000 feet and horizontally beyond the coast up to 30-40 miles, depending on its strength. Owing to its thermal contrast from the seasonal winds, the land breeze would act like a cold front. The prevailing moist westerlies ensure a higher wet-bulb temperature in the lower levels and create a thick environment of latent instability. This is particularly so at coastal stations where dew points are usually high in the surface layers. This environment commences from about 2,000 feet, as borne out by the observed height of cloud base. Hence, as soon as the advancing wedge of cold air lifts up the surface layers of the atmosphere into this environment, vigorous convection is set up, and thunderclouds develop. The trigger for the release of energy in the atmosphere resulting in the morning thunderstorms, therefore, seems to be the land breeze at the coast itself.

It will also be noticed from Table I, that the time of commencement of the thunderstorm as well as the distance from the coast where it forms depend on the magnitude of the minimum temperature. The lower the minimum temperature the closer to the coast do these clouds form and the earlier in the morning. This inference would be helpful in anticipating the time of occurrence of these thunderstorms. As the nocturnal cooling of the ground layers of the atmosphere determines the value of the minimum temperature, the clearer the skies at night, the earlier can the thunder-clouds be expected to develop. The probable isobaric situation towards the morning hours must, of course, be taken into account in deciding upon the nature of the land breeze. Katabatic winds, if present, and the cooling of the ground layers of the atmosphere due to past precipitation would augment the effect of the land breeze.

The author's thanks are due to Mr. B. N. Sreenivasaiah, Meteorologist, Madras, for his kind interest in the work.

Meteorological Office,
St. Thomas Mount,
Madras, C. A. GEORGE.
*February* 20, 1948.

1. Sreenivasaiah, B.N., *Some Features of Madras Weather*, Technical Note No. 23, India Meteorological Department. 2. *Indian Daily Weather Report*, May 1944, India Meteorological Department.

## OBSERVATIONS ON NITRITE-PRODUCING BACTERIA FROM DIFFERENT SOURCES AND THE ROLE OF PROTOZOA IN NITRIFICATION

DURING recent years, there has been increasing evidence to show that, apart from the special forms of nitrifying bacteria (species of *Nitrosomonas* and *Nitrosococcus*), there are other types of bacteria commonly occurring in soil and other systems which are capable of producing nitrite fro mammonium salts.[1-3] We have carried out some studies on the occurrence and distribution of nitrite-forming bacteria in natural systems, such as water, sewage, soil and compost, and also on the extent of their activity in these media. The nitrifying activity of these bacteria, individually and collectively, as also in presence of certain forms of protozoa (*Vorticella* sp. and *Epistylis* sp.) which have been

found to influence nitrification in Activated Sludge,[4,5] has also been studied.

Out of the eighty-one different strains of bacteria isolated on nutrient agar and other media from samples of water, soil, sewage, compost and fæces of animals (the bacteria characterised according to Bergey[6]), thirty-seven were found to produce nitrite (sixteen of these produced only traces of nitrite) in aqueous suspensions of soil, sewage and compost materials. The observations on the nitrite-forming bacteria and the amounts of nitrite produced by the different bacteria, singly and in combination, as also the influence of protozoa on nitrification are given in Tables I and II. The effect of addition of small amounts of Activated Sludge and septic tank sludge on nitrification in the medium was also studied.

Nitrification in aerated sewage and other media was found to start only after the flocculation of the suspended and colloidal matter in the media: formation of nitrite was found to proceed after aeration for 24 to 72 hours, largely depending upon the nature and concentration of the organic matter and the inoculum; and production of nitrate was found to take place as the aeration was prolonged after 72 to 96 hours.

The observations given in Tables I & II show that the nitrite-producing bacteria are commonly distributed in nature and that the amounts of nitrite produced by the bacteria alone, singly or all together, are less than those formed in presence of certain forms of protozoa, such as the *Vorticellids* occurring in Activated Sludge.

TABLE I

*Extent of nitrite production by the individual strains of bacteria from different sources, with and without* Vorticella *sp. (after aeration of the medium for 96 hours)*

| Sources examined | No. of different strains of bacteria isolated | Media employed for the nitrification test (800 c.c.) | No. of nitrite-formers observed | Nitrite produced (p.p.m.) | Nitrite produced by bacteria in presence of *Vorticella* sp. (p.p.m.) |
|---|---|---|---|---|---|
| River water .. | 2 | Sterilised sewage | 1 | 0·06 | 2·53 |
| Tank water .. | 6 | ,, | 5 | traces to 0·08 | 0·2 to 3·0 |
| Borewell water .. | 3 | ,, | 2 | traces to 0·08 | 0·25 to 1·50 |
| Garden soil .. | 6 | Sterilised soil suspension | 1 | traces | 0·35 to 0·60 |
| Compost heaps .. | 13 | Sterilised compost extract | 2 | traces to 0·04 | 0·12 to 2·0 |
| Raw sewage .. | 3 | Sterilised sewage | 1 | 0·04 | 0·06 to 0·08 |
| Septic tank sludge .. | 2 | ,, | 1 | 0·04 | 0·08 |
| Activated sludge .. | 3 | ,, | 3 | 0·04 | 0·12 to 0·20 |
| Cow dung .. | 7 | , | 3 | traces to 0·04 | 0·08 to 0·12 |
| Horse dung .. | 8 | ,, | 2 | traces | 0·25 to 3·0 |
| Fæces of rat, rabbit, dog and monkey | 28 | ,, | 16 | traces to 0·06 | 0·07 to 3·80 |

1. c.c. of active bacterial culture was used as inoculum in each case; the protozoan inoculum contained about 20,000 active cells of *Vorticella* sp.

TABLE II

*Effect of addition of mixed cultures of bacteria, protozoa, and sludges to suspension of soil, sewage and compost on nitrification in the medium (after 96 hours' aeration)*

| *Treatments* (in each case 2 litres of sterilised suspension of soil and compost extracts and sewage mixed in the proportion of 1 : 1 : 1) | Nitrite nitrogen (p.p.m.) | Nitrate nitrogen (p.p.m.) |
|---|---|---|
| Mixed cultures of all the 81 strains of bacteria | 0·04 | Nil |
| Washed cells of *Vorticella* sp. .. | 0·40 | traces |
| Washed cells of *Epistylis* sp. .. | 1·80 | 0·80 |
| Activated sludge .. | 2·50 | traces |
| Septic sludge .. | 0·30 | Nil |

The percentages of nitrification by the bacteria associated with the protozoa and in the sludges were found comparatively negligible; the number of active protozoa in the protozoan inocula and in the activated sludge introduced was about 22,000 in each case; the septic sludge also contained a corresponding number of protozoa including *Vorticella* sp. but mostly in the form of cysts which on aeration became active.

Department of Biochemistry, S. C. PILLAI.
Indian Institute of Science, T. K. WADHWANI.
Bangalore, M. I. GURBAXANI.
*December* 30, 1947. V. SUBRAHMANYAN.

1. Cutler, D. W., and Mukerji, B. K., *Proc. Roy. Soc.*, **1931**, **B 108**, 384. 2. Winogradsky, H., *Ann. Inst. Pasteur*, **1933**, **50**, **350**. 3. Russell, E. J., 'Soil conditions and plant growth,' 1937, Longmans, Green & Co., 369. 4. Pillai, S. C., *Ind. Med. Gazette*, 1942, **77**, 118. 5. Pillai, S. C., and Subrahmanyan, V., *Nature*, 1942, **150**, 525. 6. Bergey, D. H. *et al.*, 'Manual of Determinative bacteriology', 1939, Baltimore.

## INFLUENCE OF HEAT ON THE PHYSICO-CHEMICAL PROPERTIES OF GUM-ARABIC

GUM-ARABIC, an acid polysaccharide, is mainly a calcium salt of arabic acid,[1] the nucleus of which is aldobionic acid (galactose-glucuronic acid) to which sugar molecules of galactose, arabinose and methyl pentose are attached.

Gum-arabic (composition :—Pentosan 34·34 per cent.; Galactan 33·93 per cent.; moisture 15·53 per cent.; Ca 0·6459 per cent) when heated to 170° C., and then introduced into water swells up to a considerable extent, but does not dissolve; and the gel thus formed is non-sticky. There is practically no change in the chemical composition of the gum on heating it from 100°-170° C. The insolubility of the gum at 170° C., can be explained to be due to complete dehydration. On dehydration some of the molecular groups approach so closely[2] that when they are again brought in contact with water, their attraction for water molecules or its ions is unable to separate them.

The viscosity of the gum solutions goes on increasing (the relative viscosity of 6 per cent. solutions of the gums heated to 100° and 150° C., being 3·780 and 5·898 respectively) as the gum is heated from 100°-150° C. The increase in viscosity is due to the increase in the imbibed water. Water appears to be oriented in a shell surrounding the gum micelles and thus the disperse phase becomes, highly solvated which results in the increase of viscosity. This view is further confirmed from the results of dilatometric experiments—in which the volume contraction is found to increase with the temperature to which the gum has been heated.

Action of NaOH on the gum heated to different temperatures was studied potentiometrically. The quantity of NaOH required for reaching the neutral point goes on increasing with the rise of temperature. The quantities of 0·02N NaOH required to neutralise the acidity of 2 gms. of heated gum to 110° C. and 170° C. are 4·55 and 14·3 c.c. respectively. The phenomenon is explained on the basis of difference between the ionisation of calcium and sodium arabates, and due to the different hydration of calcium and sodium ions as found by David R. Briggs.[3]

The full paper on the subject will be published elsewhere.

Chemical Laboratories, D. J. Sind College, Karachi,
*February* 5, 1948.

M. N. Moorjani.
C. S. Narwani.

1. Butler, C. L., *J. Amer. Chem. Soc.*, 1929, **51**, 1519. 2. Alexander, J., *Ibid.*, 1921, 438. 3. David R. Briggs, *J. Phy. Chem.*, 1931, **35**, 1929.

## EEFECT OF NITROGENOUS FERTILIZERS ON THE RESPIRATION RATE OF POTATO TUBERS

Overholser and Claypool[1] and Harding,[2] working with strawberry and apple respectively, recorded a higher respiratory activity in fruits from plants, manured with nitrogenous fertilizers as compared to the control. The author has studied the effect of nitrogenous fertilizers on the respiratory activity of potato tubers of the variety, Darjeeling Red, grown at the Agricultural College Farm, Benares Hindu University, during 1943-44 and fertilized with ammonium sulphate at 40 and 80 lbs. N per acre, applied before planting. Tubers of almost equal size from control and manured plots were collected and their respiratory activity studied. For determining the respiration rate of tubers, the usual method of drawing $CO_2$ through Pettenkofer tubes containing baryata water was followed. The quantity of $CO_2$ absorbed by baryta water was estimated by titrating against standard HCl and the indices of respiration were computed by reducing the values to the unit fresh weight of the experimental material. The effect of nitrogenous fertilizers on the respiration rate of the potato tubers is given below.

Table I

*Carbon dioxide evolved (mg./gm. of tubers) per hour at 30° C. in tubers*

| Days after planting | Control | Manured Plot | |
|---|---|---|---|
| | | 40 lb. N. per acre | 80 lb. N. per acre |
| | | Mean values | |
| 64 .. | 0·134 | 0·207 | 0·327 |
| 78 .. | 0·122 | 0·252 | 0·327 |
| 92 .. | 0·164 | 0·245 | 0·314 |
| 103 .. | 0·160 | 0·214 | 0·262 |

It will be noted that the tubers obtained from the manured plots showed a higher rate of respiration at all the stages of tuber development. Sircar[3] also found that potato discs on absorption of ammonium nitrate showed an increased respiration rate.

It is generally believed that the material with a higher respiration rate has a poor keeping quality, and this was confirmed when the greater losses during storage were recorded with the tubers from the manured plots of this experiment.[4]

I am thankful to Prof. K. Kumar of Benares Hindu University, for helping me in the preparation of this note.

Department of Botany, University of Delhi,
*February* 20, 1948.

S. L. Tandon.

1. Overholser, F. L., and Claypool, L. L., *Proc. Amer. Soc. Hort. Sci.*, 1931, **28**, 220. 2. Harding, P. L., *Iowa Sta. Tech. Bull.*, 1935, **182**, 313. 3. Sircar, S. M., *Indian J. Agric. Sci*, 1943, **13**, 382. 4. Kumar, K., and Tandon, S. L., *Curr. Sci.*, 1946, **15**, 318.

## SETT ROOTS IN SUGARCANE

Sugarcane is vegetatively propagated by planting setts. At every node above the leaf-joint there is a region of root-initials (keimring). When setts are planted in the field, roots develop from these root-initials, and these are termed "sett roots", in contrast to the roots that develop from the sprouted bud at the same node and which are called "shoot-roots". Barber[1] and Venkataraman *et al.*[2] emphasized the importance of sett roots for the full development of the bud into a shoot. That the sett roots function only temporarily in the early stages and that the shoot-roots replace them have also been pointed out by the same authors.

By anatomical studies in this laboratory, it was noted that the buds are more intimately connected with the inner storage tissues of the sett, while the sett roots are more superficial. It was also noted under a variety of field as well as laboratory conditions that the bud could sprout and grow while the root-initials are dormant. These two facts led us to re-investigate the importance of sett roots in the early stages of germination in cane setts.

The root-initials were artificially removed with a scalpel, and the setts were planted both in pots and in the field. The buds sprouted normally (Fig. 1) and the seedlings developed

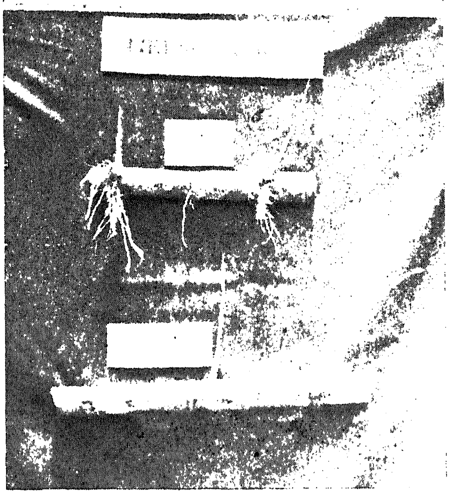


FIG. 1

FIG. 2

into normal crop (Fig. 2). Preliminary studies in these two types of treatments (normal and setts without nodal root-initials) revealed some possible physiological consequences as already indicated by Barber and Venkataraman *et al.* (*loc. cit.*). The absence of sett roots does not affect germination (*vide* Table I) because the sett has already enough moisture and reserve food readily available and accessible to the bud.

TABLE I

| Character | Normal | Root-initials removed |
|---|---|---|
| Germination % | | |
| 10 days .. | 43·3 | 38·5 |
| 20 days .. | 50·2 | 50·6 |
| 30 days .. | 50·9 | 51·1 |
| 40 days .. | 50·9 | 51·1 |
| Tillers/Bud :— | | |
| After 5 weeks .. | 1·19 | 1·67 |
| After 4 months .. | 2·40 | 2·70 |
| Height :— | | |
| After 5 weeks .. | 25″ | 28″ |
| Leaf length } After 5 weeks | 40·2 | 39·8 |
| Leaf breadth } After 5 weeks | 0·05 | 0·84 |
| Number of leaves after 5 weeks | 7·0 | 7·6 |

After sprouting, the absence of sett-roots forces the shoot to develop its own shoot roots, and thus it was actually noticed that shoot-root development is much earlier in the second of the treatments mentioned above.

Khanna and Venkataraman[3] stated that tillering generally commences only after the development of shoot roots. Presumably this is the reason for the larger number of tillers recorded by us in the second treatment (*vide* Table I). The same authors have emphasized that shoot roots are more vigorous than sett roots and also that there exists a positive correlation between shoot-root vigour and the vegetative vigour in the cane.

Our studies reported here open up the possibilities for inducing early development of shoot-roots and thus take advantage of all the possible favourable physiological consequences of the same. Lastly we wish to emphasize and point that neither the sett roots nor the shoot roots are analogous to the seminal roots of the graminaceous plants. The buds of sugarcane can thus be independent of the sett roots for their nutrition and development, in the early stages; but are directly dependent on the shoot roots. Further studies to utilise this phenomenon in agronomical practice are in progress.

S. V. PARTHASARATHY.
B. APPAJI RAO.
Sugarcane Research Station,
Anakapalle,
*February* 27, 1948.

1. Barber, C. A., *Agr. J. India*, 1920, **15**, 185. 2. Venkataraman, T. S., *et al.*, *Ibid.*, 1922, **17**, 38. 3. Venkataraman, *et al.*, *Mem. Dept. Agr. India*, 1929, **16**, 145.

## PHARMACOLOGY OF PHOSPHANILIC ACID

IN continuation of the study of the antibacterial properties of phosphanilic acid by Kanitkar and Bhide[1] it has been now found that phosphanilic acid also inhibits the growth of *M. tuberculosis in vitro* at a concentration of 1 : 5000.[2] This has led us to the study of the pharmacology of this drug, and this preliminary note gives the results of absorption in blood and toxicity of

phosphanilic acid to laboratory animals after administration of its solution in the minimum quantity of sodium bicarbonate.

*Absorption in Blood.*—Phosphanilic acid (300 mgms.) was given orally to a guinea-pig (wt. 600 gms.). There were no signs of irritation of the stomach. Phosphanilic acid was estimated after six hours in the blood from the heart, by Bratton and Marshall's[3] method of estimation of sulphanilamide. The drug, however, was not present in the blood.

Similar experiments were carried out with mice (weight 20 gms.) (dose 20 mgms.). But the drug was found to be absent in the blood. In the urine and fæces, however, it was present in considerable amount.

4 gms. of the drug were orally administered to a dog, on empty stomach, through a stomach tube. There were no signs of irritation of the stomach or vomiting. Blood removed from the vein of the leg after one hour, two and five hours was found to contain 1·12, 0·56 and 0·42 mgms. per cent. of the drug respectively. After 24 hours there was a negligible quantity of the drug in the blood.

*Toxicity to laboratory animals.*—Ten mice were fed with the drug (15 mgms. at a time, three times a day) for ten days. All the animals survived with slight loss in weight and a little disturbance of fur and loss of appetite. When the drug was discontinued they recovered their normal condition very soon. The blood from the heart was examined, but phosphanilic acid could be found only in traces. Histological examination of the solid organs of the animals such as liver, spleen, kidneys, etc., showed no damage excepting some changes similar to autolytic changes in the liver cells. Phosphanilic acid was not found in the liver at all but only in urine and fæces.

The drug, therefore, deserves further trials in intestinal infections as it possesses good antibacterial activity and is poorly absorbed even if given in large doses.

We thank Dr. B. B. Dikshit, Dean of the B. J. Medical College, Poona, for his advice and the interest in the work.

Maharaja Pratapsinh Chemical Lab.,
Sir Parushurambhau College, Poona,
G. S. PENDSE.
B. V. BHIDE.
*March* 11, 1948.

1. Kanitkar and Bhide, *Curr. Sci.*, 1947, **16**, 223. 2. Unpublished observation. 3. Bratton and Marshall, *J. Biol. Chem.*, 1939, **128**, 537.

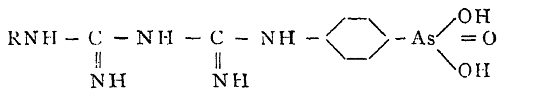
## STUDIES IN ANTI-MALARIALS: BIGUANIDO-ARYL-ARSENICALS

IN spite of the various antimalarial drugs available for therapy, treatment of relapsing cases of malaria is considered a very difficult problem. It is known that the benign tertian and the quartan forms of the malarial parasites defy radical treatment and lead to persistent relapses. To free the system from these resistant forms, synergistic treatment with organo-arsenicals[1,2,3] has been advocated.

With a view to studying the pharmacological properties of organoarsenicals having certain essential structural features of the reputed antimalarial drug, paludrine,[4,5] several biguanido aryl-arsenicals of type (I) have been synthesised by reacting cyanoguanidine (for compound No. 1) and aryl cyano-guanidines (for compounds 2–6) with excess of para-arsanilic acid hydrochloride in dilute alcoholic medium. The arsonic acids separated out from the reaction products on neutralisation with dilute alkali and were then purified. The sodium salt of the acids were prepared and characterised. All the acids excepting No. 1 (Table I) and their sodium salts contain water of crystallisation and do not melt even at 300° C. Compounds Nos. 1 and 5 were crystallised from hot water; the others being insoluble in hot water and common organic solvents, were purified by precipitating with acids from alkaline solutions. They are soluble both in acid and alkali and are colourless.

TABLE I

$N^5$-*R*-($N^1$) p-*biguanido phenyl arsonic acids*



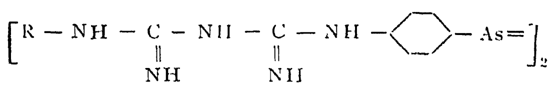
[ Type(I) ]

| No. | R | Water of crystallisation in mols. | |
|---|---|---|---|
| | | Arsonic acid | Sodium salt |
| 1 | H– | Nil | 6 |
| 2 | $C_6H_5$– | 1 | 4 |
| 3 | *p*-$CH_3C_6H_4$– | 1 | 4 |
| 4 | *p*-$OCH_3 \cdot C_6H_4$– | 1 | 5 |
| 5 | *p*-$Cl \cdot C_6H_4$– | 2 | 5 |
| 6 | *p*-$NH \cdot Ac.C_6H_4$– | .. | 5 |

It is now widely accepted[6] that pentavalent arsonic acids become therapeutically active only on reduction, in the body, to the trivalent state. In view of these observations, some compounds of the type (I) have been reduced with hypophosphorous acid and potassium iodide to the corresponding arseno-derivatives (type II),

TABLE II

p-p′-*Di* ($N^5$-*R-biguanido*) *arseno benzenes*



(Type II)

| No. | R | Water of crystallisation in mols. | | M-P. with decomp. |
|---|---|---|---|---|
| | | Arseno compound | Dihydrochloride | |
| 1 | *p*-$CH_3C_6H_4$– | 4 | 2 | 228° C. |
| 2 | *p*-$OCH_3C_6H_4$– | 2 | 2 | 225° C. |
| 3 | *p*-Cl–$C_6H_4$– | 2·5 | 2 | 230° C. |
| 4 | $C_6H_5$– | Unstable | .. | .. |
| 5 | H– | Not determined | .. | .. |

which are fairly stable and practically insoluble in water. The yellow arseno-compounds possess no definite melting points, but their hydrochlorides melt with decomposition.

Full details will be published elsewhere.

Organic Chemistry Laboratories, A. C. Roy.
Indian Institute of Science, B. H. Iyer.
Bangalore, P. C. Guha.
*March* 15, 1948.

1. Goldman, *Amer. J. Med. Sci.*, 1938, **196**, 502. 2. Murphy, *South Med J.*, 1929, **22**, 363. 3. Bose, *Indian J. Pharmacy*, 1947, 2, 14. 4 Curd and Rose, *J.C.S.*, 1946, 720. 5. Bami, Iyer and Guha, *J. Indian Inst. Sci.*, 1946, **29A**, 1.

## LIFE-HISTORY, BIONOMICS AND CONTROL OF JOWAR STEM-BORER (*CHILO ZONELLUS* SWINHOE)

*Jowar* (*Andropogon sorghum*) crop is usually attacked by stem-borers, such as *Chilozonellus*, *Sesamia inferens* and *Anthomyiad* flies, of which the first one is of considerable significance in the Bombay Province. The percentage of infestation at Poona varied from 57·7 to 79·4 in different varieties of *jowar* during 1945-46. Previous reports, however, indicate the maximum infestation going up to 86 per cent. in Surat during 1925-26.

The literature on this pest being very meagre, investigations were taken up with a view to studying the systematics of this species as well as its bionomics and other details.

An inquiry among entomologists showed that Rahman (Punjab) and Lal (U.P.) are of the opinion that *C. zonellus* is a synonym of *C. simplex*, whereas Hinton (London) and Cherian (Madras) differ from them in this respect.

Since considerable controversy existed about the presence of two species, namely, *C. zonellus* and *C. simplex*, detailed study was made in this respect, and all the characters were compared with the descriptions and diagrams collected from various countries like Japan, China and the British Museum, London. In India, species were collected from Poona, Padegaon and Delh on different food plants, namely, *jowar*, maize sugarcane, rice, grasses, etc., and their characters noted.

Our investigations have shown that *C. simplex* and *C. zonellus* are two distinct species, and the species on *jowar* in India is exclusively *C. zonellus*. Its detailed life-history, seasonal history and the effect of different environmental factors on differentstages, have been thoroughly worked out. The nature and extent of damage has been studied and some control measures tried. Parasitization in nature was studied and the different species of parasites recorded.

There are 4 to 5 generations a year, and each life-history may occupy 29 to 210 days, depending upon temperature, overlapping of generations being not uncommon. The egg stage lasts for 4 to 9 days, caterpillar 18 to 193 days and the pupal 6 to 12 days. Hibernation during winter is in the caterpillar stage. Alternat ve host plants include many of the millets and other wild grasses. It is parasitized by *Dipterous* and *hymenopterous parasites*, the most important being a *tachnid* fly. Preventive methods of control, namely, destruction of "dead-hearts" at the time of thinning, are of practical importance. Exposing the *jowar* stalks or stubbles to direct Sun's heat for 2 to 3 months, or burying the stubbles 5″ below the earth for more than a month, kills all the hibernating caterpillars.

The detailed accounts of our findings are being published separately.

College of Agriculture, K. N. Trehan.
Poona 5, D. K. Butani.
*April* 1, 1948.

## TRIALS WITH 666 AGAINST INSECTS AFFECTING GRAINS IN STORES

The toxicity of Gammexane to the rice weevil, *Calandra oryzæ* L., the red flour beetle, *Tribolium castaneum*, and the saw-toothed beetle, *Silvanus surinamensis*, was determined by (1) mixing the insecticide with the grains, (2) dusting the inside of bags, (3) dusting the godowns and outside of the bags.

One lb. of wheat grain mixed with Gammexane, D 230, and 100 specimens of each of the three species of insects were introduced separately into 2 lb. jars. The insecticide at five different levels of concentration was tried as shown in Table I. The experiment together with control was replicated three times. Temperature and humidity were recorded daily.

Table I

*Effect of Mixing D. 230 with Wheat*

| No. | % D 230 mixed with talc | Percentage mortality of insect at 2-day intervals. (Average of three replications) | | | | | | | | | | | | % 666 on grain |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2 | | | 4 | | | 6 | | | 8 | | | |
| | | Pecentage Mortality | | | | | | | | | | | | |
| | | C | T | S | C | T | S | C | T | S | C | T | S | |
| 1 | 0·1 | 70 | 20 | 64 | 83 | 28 | 74 | 90 | 38 | 74 | 100 | 52 | 86 | 0·0002 |
| 2 | 0·3 | 76 | 40 | 67 | 92 | 52 | 75 | 9· | 64 | 77 | 100 | 84 | 87 | 0·0006 |
| 3 | 0·4 | 82 | 60 | 68 | 96 | 64 | 74 | 96 | 70 | 80 | 100 | 84 | 90 | 0·0008 |
| 4 | 0·45 | 86 | 64 | 72 | 96 | 65 | 75 | 97 | 73 | 82 | 100 | 93 | 94 | 0·0009 |
| 5 | 0·5 | 86 | 68 | 74 | 98 | 70 | 78 | 100 | 76 | 86 | .. | 95 | 97 | 0·001 |
| 6 | 0·5% Talc. | 36 | 12 | 4 | 46 | 32 | 21 | 52 | 40 | 27 | 60 | 48 | 34 | Nil |
| 7 | Control | 18 | 0 | 8 | 27 | 16 | 17 | 36 | 25 | 25 | 48 | 34 | 33 | Nil |

*C*=*Calandra oryzæ*. *T*=*Tribolium castaneum*
*S*=*Silvanus surinamensis*

The above table shows that 0·5 per cent. D 230 gave a 100 per cent. kill of *Calandra oryzæ* in 6 days. Other strengths also gave a 100 per cent. kill of the same insect, but in 8 days. *Tribolium castaneum* and *Silvanus-surinamensis* were less affected by the insecticide, and cent. per cent. mortality of these insects was not obtained in the same period required to kill *Calandra oryzæ*.

Gunny bags of five lb. capacity were dusted on the inside with D 230, two lbs. of infested wheat was then introduced into each bag. The percentage mortality of *Calandra oryzæ* is shown in Table II.

Dusting of bags at 1 per cent. D 230 kills all the insects after about 7 weeks, and the effect of the treatment lasts even after 11 weeks.

Three godowns, each of 1,200 cft. capacity, containing 108, 105 and 210 bags of both rice and wheat were dusted with the insecticide at the different levels as shown in Table III. A fourth godown containing 100 bags was left untreated as control. The percentage mortality of *Calandra oryzæ* is given below.

TABLE II

*Effect of dusting bags with D 230 on Insect Mortality*

| No. | % D 230 with talc. | Percentage mortality of *Calandra oryzæ* | | |
|---|---|---|---|---|
| | | 20 days | 51 days | 81 days |
| 1 | 0·25 | 14 | 50 | 35 |
| 2 | 0·5 | 46 | 75 | 100 |
| 3 | 1 | 50 | 100 | 100 |
| 4 | Control | 5 | 8 | 28 |

TABLE III

*Percentage mortality of* Calandra oryzæ *in treated godowns in a period of four days*

| No. | % D 230 with talc | Room No. | Percentage mortality of rice weevil before dusting | Percentage mortality of *Calandra oryzæ*—days after dusting | | |
|---|---|---|---|---|---|---|
| | | | | 2nd | 3rd | 4th |
| 1 | 0·24 | 1 | 6·24 | 35·9 | 27·3 | 27·1 |
| 2 | 0·5 | 2 | 2·8 | 40 | 62·5 | 54·1 |
| 3 | 1 | 3 | 8·3 | 100 | 100 | 100 |
| 4 | Control | 4 | 3·1 | 7·2 | 6·1 | 8·4 |

The table shows that 1 per cent. D 230 gives cent. per cent. mortality on the second day.

All these data show that if all these treatments are applied simultaneously large quantities of grains can be saved from insect pests, especially from *Calandra oryzæ* which is the chief and serious pest of grains in stores.

Entomological Section,
Department of Agriculture,
Hyderabad (Dn.), M. QADIRUDDIN KHAN.
*March* 23, 1948.

## INSECT PESTS OF STORED GRAINS IN BOMBAY GODOWNS

BEFORE war, Bombay didn't feel the necessity to import the grain from abroad, and whatever was imported from other provinces, was not stored for any considerable period, but it was disposed off immediately. Since 1944, however, the foodstuff was imported from outside and the introduction of rations resulted in stocking the food grains in godowns.

Before 1944, about thirteen species of store pests were recorded of which only five were of major importance. After 1944, however, the number of insects infesting stored grains went on increasing a list of which is given below.

TABLE I

*Insect Pests in Stored Grains in Bombay*

| Scientific name | Food grains infested | Status | Remarks |
|---|---|---|---|
| *Insects recorded up to* 1944 | | | |
| 1 *Sitophilus oryza* L. (Small strain) .. | Wheat, Maize, *Jowar*, Bajri, Rice and Barley | Major | |
| 2 *Rhizopertha dominica* O. .. | Wheat, *Jowar*, *Bajri* and Split pulses Barley | Major | |
| 3 *Pachymeres chinensis* F. .. | Gram, Moong, Tur, Soya bean and *Urid* | Major | |
| 4 *Pachymeres analis* F. .. | do. | Major | |
| 5 *Sitotroga cerealella* O. .. | Wheat, *Jowar* and paddy | Major | |
| 6 *Corcyra cephalonica* St. .. | Rice, *Bajri*, Wheat and Split pulses | Minor | |
| 7 *Tribolium castaneum* H. .. | Damaged grains and milled products | Minor | |
| 8 *Lætheticus oryzæ* Wat. .. | do. | Minor | |
| 9 *Oryzæphilus surinamensis* L. | do. | Minor | |
| 10 *Læmophlœus minutus* O. .. | Rice and Wheat | Minor | |
| 11 *Alphitobius picous* O. .. | Wheat, Rice, *Jowar*, Bajri, *Barley* and Pulses | Minor | |
| 12 *Tenebroides mauritanicus* L. | Wheat and Rice | Minor | |
| 13 *Periplanata americana* L. .. | Wheat *Jowar* and Rice | Minor | |
| 14 *Trogoderma granaria* E. .. | Wheat, *Bajri*, Barley, Rice, *Jowar* and Pulses | Major | Introduced from the Punjab, C.P. and Sind with Wheat and Rice |
| 15 *Plodia interpunctella* H. .. | Canadian Wheat | Major | With American Wheat, in 1945 |
| 16 *Ephestia cautella* Wlk. .. | Australian and Canadian Wheat | Major | With Australian Wheat, in 1945 |
| 17 *Sitophilus granarius* L. .. | Wheat, *Jowar* Barley and Maize | Major | With American Wheat, in 1944 |
| 18 *Sitophilus oryza* L. (bigger strain) .. | Wheat, Maize, *Jowar* and Barley | Major | With American Wheat in 1946 |
| 19 *Tribolium confusum* J.Du. | Damaged grains and milled Products | Minor | With American Wheat |
| 20 *Bruchus phaseolus* L. .. | Gram | Minor | On Gram from other provinces |
| 21 *Pyroderces rileyi* W. .. | Maize | Minor | On Maize from Argentina in 1946 |

College of Agriculture, K. N. TREHAN.
Poona 5, S. V. PINGLE.
*March* 3, 1948.

# REVIEWS

**Modern Gas Turbines.** By Arthur W. Judge. (Messrs. Chapman & Hall Ltd., London), 1947. Pp. xii + 311. Price 28*sh.*

The gas turbine has already proved itself to be a serious rival to the reciprocating engine in some important fields of use. Granted the requisite knowledge and facilities, it is cheaper to make than corresponding reciprocating engines; moreover, moderate metallurgical advances in certain directions will greatly increase the extent to which the gas turbine can outrival reciprocating engines. Thus, it may be good policy for India not to contemplate eventual manufacture of certain larger and more difficult types of reciprocating internal combustion engines but, instead, to go direct to gas turbines. It is thus patent that the subject of the book under review has a special interest for India.

To those who require to assess the possibilities and limitations of gas turbines for various fields of application, Mr. Judge's clear exposition will be of considerable help at the present stage. The author gives a brief history of the development of gas turbines and follows this with some general considerations. He then outlines the fundamentals of gas turbine thermodynamics and discusses gas turbine efficiencies and how to improve them. There follows a chapter on closed-cycle gas turbines and another on exhaust-gas turbines for supercharged engines. The next chapter deals with gas turbines for aircraft. This relates mainly to jet-engines as more experience has been gained with these engines than with those which deliver power through shafting. The concluding two chapters concern typical applications and performances of gas turbines, and materials for gas turbines. There are two short appendices which comprise notes on turbine-blade design and a description of some blade-fixing methods.

A considerable bibliography is given for the guidance of those who need to study particular aspects of the subject more fully. Important further contributions continue to appear in technical literature but the references given extend into 1946.

The book is not a design manual: it is largely descriptive, but fundamental principles and facts are stated, thus forming an excellent introduction to the subject.

Little is given concerning dynamical aspects of gas-turbine design, such as balance-whirling, vibration of turbine discs and blades, centrifugal and temperature stresses, high-speed bearings, and so forth. To a large extent these are covered by manuals on steam turbine design, but the gas turbine has its own special dynamical and stress problems. Again, heat interchangers for gas turbines are only referred to diagrammatically. However, it is to be realised that there is limitation to information released.

The book is clearly printed and is well illustrated with numerous graphs, drawings and photographs.

B. C. CARTER.

**Electrons (+ and −), Protons, Photons, Neutrons, Mesotrons and Cosmic Rays.** By R. A. Millikan. (The University of Chicago Press, Chicago. Agent: Cambridge University Press), Revised Edition, 1947. Pp. 642. 124 Illustrations. Price 30*sh.*

In 1917 the Chicago University Press published a small volume entitled *The Electron*, written by Prof. Millikan. Seven years later, a revised edition of the same book appeared. A book with the present title was first published in 1935. This itself was an expanded edition of the *The Electron.* The volume under review is the outcome of a revision and expansion of the 1935 edition, necessitated by the extra-ordinary advances made during the last twelve years, in our knowledge of these fundamental particles. The appearance of this book will be welcomed by many students of physics for whom the earlier edition has become a standard text. The first four hundred pages of the earlier edition have been reproduced in the present volume. Only minor changes, mostly in the values of units, have been made. Five new chapters (XVI-XX) covering well over 200 pages and containing entirely new material and a full discussion of the results of recent studies, especially in the field of cosmic rays and nuclear energy, have been added. It is a remarkable testimony to the author's presentation that new chapters could be added to the existing text, maintaining at the same time the continuity in the development of the subject. In order not to break the thread of the discussion in the body of the book, the author has collected the mathematical proofs and put them in Appendices at the end of the book, which are no less than ten in number.

The first eight chapters contain, among others, a detailed account of the experiments which led to an accurate determination of the electronic charge. The structure of the atom and the nature of radiant energy form the subject-matter for Chapters IX and X respectively. The next chapter on waves and particles gives a brief and clear account of the particle wave dualism in modern physics. The succeeding chapter deals with spinning electron with particular reference to the spectra of stripped atoms and the new spectroscopic rules. The discovery of the cosmic rays and the early experiments carried out to elucidate their nature and origin are described in detail in Chapter XIII. The next two chapters deal with fascinating topics such as the positron, neutron, and artificial transmutation. Only brief summaries of the experimental facts are given.

Chapter XVI, the first one of the new chapters, deals briefly with the release and utilisation of nuclear energy. Tracing the history of the discovery of nuclear fission and the possibility of large-scale release of nuclear energy, the author makes a strong plea for conserving rather than burning up a rare and precious element, namely, uranium, whose abundance is only a very small

fraction. According to him it is too valuable a material for scientific purposes to be wasted for major power projects so fully provided for by the inexhaustible supplies of solar energy. The succeeding three chapters with respective headings, "Geomagntic Studies on Cosmic Rays at Low Altitudes", "The Discovery and the Significance of the Mesotron", and "The Nature and Number of Incoming Primary Rays", deal mainly with the different aspects of cosmic ray studies carried out since 1932. Results of airplane surveys of latitude effect and east-west effect, and of sounding balloon flights that carried the electroscopes practically to the top of the atmosphere, have been described in some detail and discussed. The atom annihilation hypothesis put forward by Millikan as to the origin of cosmic rays and the evidence in support of the same have been dealt with in the last chapter. Careful studies of the latitude distribution of incoming cosmic rays carried out by Prof. Millikan and his associates in India, South America, Canada, Mexico and the United States, have been referred to in great detail in this chapter. The conclusions derived from these studies have been shown to support the predictions of the atom annihilation hypothesis.

On going through the book, especially the chapters dealing with cosmic rays, a careful reader is bound to notice an indulgence on the part of the author in presenting a detailed analysis of particular investigations with which he has been intimately associated. No doubt, these investigations are extremely interesting and important. But, the usefulness of the book would have been very much enhanced if a more balanced and critical summary of all the contemporary investigations in the field of cosmic rays had been presented. In spite of this limitation, the present volume contains an extremely useful resumé of a wide range of investigations in atomic physics. It is profusely illustrated with many charts and Wilson cloud Chamber photographs. It is written in a simple and clear, though assertive style. The book is an important addition to the literature of modern physics and should prove to be a welcome companion not only to those working on cosmic rays but also to every student of physics.

R. S. K.

**An Introduction to the Theory of Seismology.** By K. E. Bullen. (Cambridge University Press), 1947. Pp. 276. Price 18*sh*. net.

The author of the book is well-known in the field of seismology; his contribution in the form of the improved 'Travel-time Tables for seismic waves' remains an outstanding achievement. And now he brings out a new book, *An Introduction to the Theory of Seismology*, which includes in a nutshell a world of information Coming from the Jeffreys school, the author naturally puts in the forefront the views and thoughts of that eminent school; he has not, however, neglected to mention, side by side, the accepted views, if any, of the American, Japanese or German seismologists. He has taken great pains in making the complex subject of seismology as interesting as possible, by gradually approaching the actual condition from the ideal, and by weeding out the non-essentials with utmost care.

In the earlier chapters of the book the author develops the mathematical theories of elasticity and of waves and vibrations. He shows how in the investigation of earthquake phenomena both the vibration theory based on normal mode considerations and the wave theory can be applied. The concept of rays is then introduced in dealing with the propagation of waves in three dimensions, and, on this consideration, characteristics of the waves are clearly brought out. Chapters dealing with seismic waves have been thorough and most useful. His method of presentation is clear and convincing. For example, in determining the cause of the oscillatory movements that are observed at the surface he introduces at first several factors which may contribute, but, after discussing one by one in detail, shows that the essential cause of the observed oscillatory movements must be sought in the heterogeneity of the Earth. Similarly, it has been shown how the possible effects of departures from isotropy due to initial stress become insignificant even when second-order terms are taken into account; logical conclusion that follows is that in seismology the first-order theory will lead to very accurate results in most problems. Bodily waves and surface waves have been considered in great detail and special attention devoted to Rayleigh and Love waves. Since seismic waves penetrate all parts of the Earth's interior and emerge at the outer surface, bringing evidence of the regions they have traversed, study of these waves would naturally lead to useful information. The book includes many advances that have been made in this direction. Indications have been given as to how the elastic parameters of the Earth's crustal layer as well as of the interior can be investigated, and several discontinuities and transition layers so far discovered within the Earth are included in tabular form. A good portion of the book is devoted to discussion on earthquakes, their causes, intensities, epicentral distance and focal depth; it includes the useful table of Gutenberg and Ricter showing the distribution of deep-focus earthquakes.

One feels that the chapter on the principle of the seismograph has been rather brief. This part could probably be expanded with fully developed equations using terms of the second order for the benefit of those engaged in the design, and construction of instruments.. If the principal features of all the modern types of seismograph were included together with their illustrations, perhaps the value of the book would have been further enhanced. A page on bibliography could also be usefully added at the end.

The author is to be congratulated in having succeeded in his attempt to present so elegantly the essentials of the theory of seismology in so few pages. The book will undoubtedly be endeared by all interested in seismology.

J. M. Sil.

**Dissociation Energies and Spectra of Diatomic Molecules.** By A. G. Gaydon. (Chapman & Hall, Ltd., London), 1947. Pp. xi + 239. Price 25*sh*. net.

While giving an appreciation of another book, *The Identification of Molecular Spectra* (*Curr. Sci.*, 1941, 12, 541), of which Dr. Gaydon was part author, we expressed a wish that

other data should have been included. The present book supplies part of the need thus felt: It brings together a critically assessed mass of information regarding the dissociation energies of some 263 diatomic molecules, the value being uniformly based on up-to-date values of the fundamental physical constants, $c$, $h$, c etc. As an introduction to this collection a description is given of the various methods by which dissociation energies are evaluated, *viz.*, convergence limits, Birge-Sponer extrapolation, predissociation, electron impacts and thermochemical methods. The application of these methods is also illustrated in detail in the case of certain molecules like $N_2$, $N_2^+$, NO, CO, $CO^+$, CN, $F_2$, HF, $C_2$, OH, $S_2$, SO, $Se_2$ etc., where the author has suggested values which are free from some of the errors associated with older values. In discussing the data leading to the new values, Dr. Gaydon shows himself an impartial and discriminating critic. The first three chapters give a resumé of the theory of diatomic molecular spectra sufficient to follow the notation and the discussion in the later chapters. Reproductions of spectra are also given so as to illustrate some of the points discussed. The book not only serves a very useful purpose in itself but also provides an admirable model to be followed when a research worker wants to survey the existing literature and make up a list of data and results relating to any subject in which he is interested. Excepting that the price seems high according to pre-war standards, the book will certainly commend itself to all workers in the field of molecular spectra.

T. S. S.

Fundamentals of Photography. By Paul E. Boucher. (D. Van Nostrand Co., Inc., New York), 1947. Pp. 395. Price 22*sh.* 6*d.*

Although books on Photography are legion to-day, and attract unfailing attention on the stalls of any bookseller of standing, it is well known among senior workers in the field that the percentage of really dependable and worthwhile publications is very small. For the scientific worker or the serious student of photography, there have been on the market only two or three treatises on the subject which have proved authoritative, and reasonably comprehensive; Paul Boucher's *Fundamentals of Photography* is one of these books. It is undoubtedly a pleasure to notice that Messrs. Van Nostrand Co. have brought out recently a revised second edition of this already reputed text-book.

"A course in photographic technique should be pursued with the same systematic concentration both in theory and practice as any other scientific subject," stated Mr. Lockington Vial, one of Britain's leading scientists, who has made distinctive contributions to the progress of photographic science. The principle enunciated above has been fully kept in view in the preparation of the book under review. Every chapter has been written with such great care and clarity, that no statement is dubious or incorrect, while at the same time brevity and compactness have been attained by the elimination of unnecessary repetition and circumlocution. The entire ground of technical and scientific photography, including colour photography, X-ray photography and motion picture photography, is covered without omitting any relevant topics. A unique feature of the book is the series of laboratory experiments described at the end of the volume. These cover nearly 100 pages, and have been so systematically planned that any student who goes through the 25 experiments in a good photographic laboratory should gain a perfect mastery over the practical aspects of photographic technique, and the scientific basis of all photographic processes. The appendices and the glossary at the close of the book are indeed very useful and informative. The book is undoubtedly a boon to students and scientific workers who may be looking out for a really compact and up-do-date text-book on the subject, but that does not lessen the value of the book as a guide and reference manual for all amateur and professional photographers in general.

I cannot, however, fail to make one observation. It is usual in text-books on photography to devote the first chapter to the historical development of photography, since it makes not only interesting reading but also provides a definitely better understanding of the latest developments and modern methods. One well-known author of a text-book on photography has allowed 60 pages out of a total of 600 pages, to the history of photography, and there may be some difference of opinion as to whether such a detailed treatment is called for. Paul Boucher has, however, erred on the other extreme by dismissing the subject in less than two pages of his book. This is scant courtesy to a topic that covers a century of progressive developments, and it results in the omission of such great names as Fox Talbot, who made outstanding contributions to the development of photography in the first half of the 19th century. The book would increase considerably in usefulness if the historical outline is extended a little more.

Notwithstanding this criticism the book is an extremely valuable treatise that can be heartily recommended to every serious student of photography.

S. Lakshminarasu.

Frequency Modulation Engineering. By Christopher E. Tibbs. Foreword by Leslie H. Bedford. (Chapman and Hall, Ltd., London), 1947. Pp. 310. Price 28/-.

The present volume is a well systematised treatment of the subject of frequency-modulation engineering and makes the study of the subject as a whole easy by including wide range of topics covering every aspect of the subject within its pages. The author deals, in eleven chapters, with all the important aspects of the subject—fundamentals of frequency modulation, propagation of f.m. signals, aerials, f.m. transmitters and receivers, measurements on frequency modulation equipment and practical uses of f.m. signals. Chapter two presents the basic ideas relating to the frequency and noise structure and their suppression in a frequency modulation system, which are most appropriate and presented with great clarity. Chapter five

mainly dicusses the points concerning the propagation of ultra-high frequency signals with some reference to those of frequency modulated type. Chapter six has been devoted in its latter pages to the consideration of ultra-high frequency aerials specially for the frequency modulation system. Chapters seven, eight and nine, relating to transmitting and receiving equipment in frequency modulation systems, have been presented very well with sufficient theoretical considerations, circuit diagrams and details of commercial circuits. Chapter ten has increased the usefulness of the subject by including topics like method of measurement of frequency deviation, frequency modulation signal generator, measurement on frequency modulation receiver. Chapter eleven discusses briefly the use of f.m. systems for broadcasting, radio telephony, picture transmission, television, etc., and concludes by a reference to the recently developed pulse-time modulation system.

The author's approach to the various topics is that of a practical engineer. The work abounds in diagrams, figures, tables and information of a practical nature. The paper, printing and general get-up leave nothing to be desired. The reviewer recommends this excellent treatise on the subject to advanced students of electrical communication engineering as well as radio engineers concerned with broadcasting and communication projects.

S. P. CHAKRAVARTI.

Kemp's Handbook of Rocks—completely revised and edited by Frank F. Grout. (D. Van Nostrand Company, Inc., New York; sixth edition, third printing, 1946.) Pp. 300 + i-vii. Price 20*sh*.

This is a good text-book of Petrology although the author has set for himself the difficult objective of offering a fairly comprehensive knowledge of rocks without invoking the aid of the special techniques of the petrographic microscope. In the original form in which the book was written just about half a century ago, by the late Professor Kemp of Columbia University, it had been acknowledged as one of the most widely used text-books of the time for over a generation. However, text-books go out of date, sooner or later, and they have to 'grow' with time. Kemp's *Handbook of Rocks* has now reached in the sixth edition. The revisor and editor, Prof. Frank F. Grout, himself the author of the well-known book, *Petrography and Petrology*, has greatly enhanced the usefulness of the book under review, while retaining the charming style and method of treatment of the original author.

The fourteen chapters of the book cover all the important aspects in the study of rocks—their description, methods of classification and modes of origin. The determinative tables given in respect of the common rock-forming minerals and the igneous rocks, as also the several tabular statements listing the simple criteria for distinguishing between orthoclase and plagioclase felspars, pyroxenes and amphiboles, phenocrysts and amygdales, phenocrysts and metacrysts, etc., are likewise very useful. The field and laboratory methods are dealt with in such a manner as to offer a direct and helpful guidance to the student. The latest developments in the study of sedimentation, and the well-logging specialities have also been explained. Economic aspects of the various rocks have been pointed out.

In short, the book presents the study of rocks in a very clear and simple manner so that the average undergraduate student or any one interested in the subject, provided of course he has some previous knowledge of the fundamentals of geology, could easily follow and understand. Even the complicated and ticklish questions on the mode of classification and origin of the rocks are alluded to in terse statements. For instance, speaking of the metamorphic rocks it is said, "These excessively altered rocks are grouped into a separate, so-called 'metamorphic' division which is a sort of 'omnibus' of unsolved geological problems" (p. 23). "When dealing with metamorphic districts, the student must expect to find contradictory evidences, for a long series of events may have left in the rock a series of minerals and structures formed under a variety of conditions" (p. 250). "It is chiefly because the original cannot always be recognised that the metamorphic class of rocks was separated" (p. 253). "The dividing line between schist and gneiss is arbitrary and expert students may disagree" (p. 249). Again, look at the fine encouraging words to the students regarding the practical difficulty in distinguishing rock-types: "These errors must be expected by field workers at places, and the corrections made by laboratory study afterward are no reflection on the character of the field work" (p. 51). The text has numerous elegant expressions like these.

The book is finely printed, amply illustrated and well bound. The reviewer thoroughly appreciated reading the book with profit to himself.

M. B. R. RAO.

A Manual of Vacuum Practice. By L. H. Martin and R. D. Hill. (Melbourne University Press, Melbourne), 1946. Pp. 120.

Fundamental knowledge, in vacuum technique is as important as glass-blowing to any post-graduate student who has to start research either in physics or in chemistry. The book under review gives a nice introduction to the subject both in theory and in practice. Even to an experienced worker in vacuum technique, the book provides an interesting and illuminating reading. Theoretical portions like, molecular flow, impedance, flow through tubes, speeds of pumps and other measurements have been given in the first chapter. The usefulness of this chapter is further enhanced by the typical calculations in the design of vacuum systems at the end of the chapter. Subsequent chapters are devoted for a critical study of the measurement of pressure, description of vacuum pumps and vacuum plumbing.

The information given in the appendices is as important as the main contents of the book. Often a beginner in vacuum work will have to waste a lot of time in locating the defects of the system when the desired vacuum is not obtained. The choice of grease for the joints, the correct dehydrating agent in the circuit, the uncontaminated oil for the vacuum pump, the employment of purified mercury in the various measuring instruments, constitute but a few of

the many precautions to be taken in vacuum work. The first ten appendices give the details of manipulation in vacuum work while the next eight give useful data often required by the vacuum worker. The appendix dealing with the purification of mercury, however, is far from satisfactory. The author has omitted the cleaning of mercury with water after the nitric acid treatment. For the air distillation of mercury, a spiral of air-cooled condenser is preferable to the water-cooled condenser shown in Fig. 53. It is obvious that purification by vacuum distillation is essential when mercury has to be employed in instruments used in vacuum technique. It is surprising to find that this process has been completely omitted in the book.

M. R. A.

**The Tuberculosis Association of India—Eighth Annual Report, 1946.** By Lt.-General R. Hay and B. M. Cariappa. (Tuberculosis Association of India, New Delhi.) Pp. vii + 22 + 96.

Six months after the inauguration of the Tuberculosis Association of India World War II broke out, hampering much of the activities of the Association. The Association, however, has been able to build up during these critical years a network of non-official organisations in different parts of India and has moved public opinion in favour of accepted methods in the campaign against tuberculosis. There are to-day thirty-four Provincial and State Associations affiliated to the Central Organisation.

The Report gives an account of the various activities of the Association. The Association has built up two model institutions—The Lady Linlithgow Sanitorium and New Delhi Tuberculosis Clinic—both of which have been serving as training institutions in anti-tuberculosis work for medical personnel, health visitors and nurses. A scheme for organised home treatment has been increasingly popular at the above institutions. At the instance of the Association, tuberculosis diploma courses have been instituted at several University Medical Colleges, *viz.*, Mysore, Delhi, Calcutta and Madras.

It is gratifying to note that private individuals have evinced keen interest in publishing anti-tuberculosis literature. A pamphlet prepared by Mrs. Helen Thomas in a South Indian vernacular is a case in point, which the local Association may well utilise. Another notable feature is the appointment of corresponding members from other countries, a list of which is given on pp. 56-59. In this way, the authors hope to secure the benefit of contact with the best work and workers to be found abroad. There is also a proposal to publish an *Indian Journal of Tuberculosis* as a permanent feature of the activities of the Association.

The error on p. 7, line 6, "D.T.D. course", is to be read as "T.D.D. course". The Appendix gives an account of the various activities of the local associations together with some addresses at the Seventh Annual Meeting of the Association.

A. S. RAMASWAMY.

**Festschrift zum 60e Geburtstage von Professor Dr. Embrik Strand (1936-1939).** (Commemorative volume celebrating the 60th anniversary of the zoologist, Professor Dr. Embrik Strand.) Vols. I-V, pp. 3,438, 104 plates and 687 text-figs. Riga (Latvia, U.S.S.R.).

Those volumes, published in honour of the well-known scientist of Riga, Prof. Strand, the Director of the Systematic Zoological Institute and the Hydrobiological Institute of the Lettish University of Riga, contain 194 papers by 126 zoologists and palæontologists from 25 different countries of Europe, the Americas, Asia, Africa and Australia. Each volume is complete by itself, and may be purchased singly. The volumes may also be obtained by exchange from Professor Strand. The fifth volume (pp. 615-749), contains a complete index of all the Latin names of animals in the five volumes. Out of the 194 papers, 12 treat of general zoology, 3 of biographies of zoologists, 3 of natural philosophy, 3 of various invertebrata, 1 of protozoa, 12 of vermes, 3 of tunicata, 4 of echinodermata, 9 of mollusca, 1 of different arthropoda, 4 of crustacea, 42 of arachnida, 1 of myriopoda, 85 of insecta, 1 of various vertebrata, 1 of pisces, 3 of reptilia, 12 of aves, 5 of mammalia, and 10 of palæontology. Consequently, specialists in all groups will find something to interest them in these volumes. The contributors are usually well known scientists. Most of the papers are systematic, faunistic and zoo-geographical, but there are also some dealing with development, physiology, biology, etc.

These commemorative volumes differ from the general run of such writings in a variety of ways. Firstly, the quantity of matter they contain is enormous, and this, in its turn, is related with the fact that an unusually large number of contributors, from practically all over the world, have collaborated in the production of these volumes. It is striking that all the contributors are foreigners and apparently not under any debt or personal obligation to Professor Strand, which shows to what an extent Prof. Strand is held in esteem by his colleagues all over the world. The volumes are sumptuously produced, lavishly illustrated, and cover a very wide range of zoological subjects. We consider that no zoological library would be complete without them. They combine in them a well-deserved tribute to the energy and devotion of Professor Strand to the cause of Zoology, as well as a practical contribution to original zoological research.

M. L. ROONWAL.

# SCIENCE NOTES AND NEWS

## World Scientific Conference

The International Scientific Conference, devoted to the discovery by the Indian Physicist, Sir C. V. Raman, of a new method of analysing the chemical composition of substances by light rays, was opened at Bordeaux on April 5th. Sir C. V. Raman was present at the Conference which was also attended by Prof. Max Born, of Edinburgh University.

## Indian Central Cotton Committee

The Government of India are sending a delegation consisting of Dr. V. G. Panse, and Messrs. R. G. Saraiya, C. S. Patel, and N. G. Abhyankar to the Seventh Meeting of the International Cotton Advisory Committee to be held at Cairo from April 1st to 8th.

The International Cotton Advisory Committee is expected to review the world cotton situation with special reference to production, utilisation and trade and to discuss the question of the progress and efficiency in production, expanding the use of cotton products, etc.

## Dr. Gilbert Fowler

Dr. Gilbert Fowler of Bangalore, S. India, has been elected an Honorary Fellow of the Institution of Sanitary Engineers in recognition of his services to sanitary science, particularly in connection with the activated sludge process of sewage purification.

He has also been elected an Honorary Member of the Engineers' Club of Manchester, England, of which he is a foundation member.

## Watumull Dental Fellowship

The Selection Board of the All-India Dental Association for the Watumull Dental Fellowship for the year 1948 have selected Dr. Baij Nath Mehra of the Calcutta Dental College. He will now proceed for two years' training in the United States of America.

## Dr. M. R. Jayakar

Dr. M. R. Jayakar has been appointed the first Vice-Chancellor of the Poona University for a period of two years.

## The Entomological Society of India

The following have been elected as the Office-bearers of the Society and the *Indian Journal of Entomology* for the year 1948:—

*President*: Dr. H. S. Pruthi.

*Editors for* 1948-50: Dr. K. B. Lal, Dr. H. S. Pruthi, Mr. R. B. Ramachandra Rao, Mr. B. C. Basu, Dr. K. N. Trehan, Dr. N. C. Chatterjee, Dr. E. S. Narayanan, Mr. M. C. Cherian, Dr. I. M. Puri.

## Prevention of Malaria

The Harvard scientists reported that they have opened the road to prevention of malaria by discovering a certain blood component which is vital to the growth and reproduction of the disease-causing parasite.

Doctors Ralph McKee and Q. Geiman of Harvard Medical School, suggested that the neutralisation of the component might eventually eliminate the tropical disease by depriving the malaria parasite of nourishment and halting its reproductive cycle. They identified the subject of their research as methionine, one of the amino acid components of protein which is present in blood plasma.

A study of metabolism and feeding habits of the malaria parasite showed that the disease-producing organism feeds on methionine and other compounds, found in plasma as well as on red blood cells which plasma surrounds. They said they started to investigate other compounds in their search for the method of neutralising such blood components in a way which would prevent the malaria parasite from drawing sustenance from them.

## Atomic Energy in India

The Prime Minister of the Indian Union introduced the Atomic Energy Bill in the Dominion Parliament on March 23rd.

Under the Bill, Government will acquire powers to control the development of Atomic energy in India and the disposal of the relevant raw materials so that these may be used for the advantage of the people as a whole.

The provisions of the Bill are drafted on the lines of the Atomic Energy Act, 1946, as obtaining in the United Kingdom.

## Blister Blight in Ceylon

Blister Blight, tea disease, which appeared on an estate in the Dolosbage area of Ceylon late in October 1946, has now spread to most of the tea districts in the Island. Climatic conditions in the Island are said to be much more favourable to its spread than in North-East India where it is reported to be existing ever since 1858. The disease has reduced, according to the latest estimate, the total production of tea in the Island by ten per cent., but the Government which is wide awake to the situation, has under contemplation several measures to check the further spread of it.

Blister Blight caused by *Fungus Exobasidium Vexans*, Massee, is mostly spread during the period of pruning when young buds and shoots are most susceptible to infection. The incubation period of the disease is said to be about three weeks.

Dr. Roland V. Norris, Director of the Tea Research Institute in Ceylon, in his annual report for 1946, published recently, says, "Bushes in North-East India are out of plucking during the winter months and are pruned during that period. In consequence, recovery from pruning during which the young buds and shoots are most susceptible to infection takes place at a time when conditions are most unfavourable to the survival of the fungus spores responsible for spreading the disease. These spores are produced in enormous numbers and it is fortunate indeed that in contrast with many other varieties of spores, they are relatively susceptible to, and their visibility greatly reduced by high temperatures and dry conditions. It may safely be assumed that it is largely due to this factor that the disease, in the ninety years during which it has been recognised, did not spread at an earlier date to South India or Ceylon.

## River Projects

Planning for multi-purpose river projects in India entered upon a new phase with the Government's establishment of a Central Designs Organisation under the Central Water-Power Irrigation under Navigation Commission.

"CWINC", as this Commission is called for short, is at present engaged in preliminary investigations of the Kosi, Mahanadi, Narbada, Tapti, Indravati and Assam Valley projects, while its investigations in respect of the Hirakud Dam Project, on the Mahanadi, have reached a stage when construction work has been authorised.

The Central Designs Organisation, which will have seven sections dealing with dam, canal, mechanical and hydroelectric engineering, technical studies, drawing and research for dams and appurtenant works, is expected to take up immediately the designing of the Hirakud Dam, the power plant proposed there and the canals and other features of the scheme. At the same time, it will prepare preliminary, and whenever necessary detailed, designs for the Kosi, Narbada, Tapti, and other projects.

It is proposed to send abroad, during the next five years, selected engineers for specialised training. These trainees to be sent out at the rate of six a year, will receive training abroad for about two years, the main centres being the U.S.A., the U.K., Canada, Sweden, Switzerland and the U.S.S.R.

The Government of India have also decided to sponsor an "International Commission on Irrigation and Canals" with its central office in this country. The Commission's objects will be to encourage progress in the design, construction. maintenance and operation of irrigation works and navigation canals by the interchange of information among its various national committees, by holding conferences, by organising studies and experiments and by the publication of reports, documents, etc. The Central Board of Irrigation will be the Commission's National Committee for India.

## Preservation of Fruit and Vegetables

Practical advice to wholesale firms, and some retail shops in the fruit and vegetable trade are given in a "Food Investigation Leaflet No. 9—Entrepot Cool Storage of Fruit and Vegetables". published by H.M. Stationery Office (Price 2d., by post 3d.). The leaflet deals with short-term refrigerated storage over a period ranging from four to ten days.

Recommendations are given for the specifications of cool stores in which temperatures ranging from 32° F. to 45° F. and a relative humidity of around 85 per cent. are maintained, with automatic control of temperature.

Details of storage temperatures for different fruits and vegetables are given, together with hints as to special treatment required for certain products. For ease of operation of the cool stores, the fruits and vegetables are divided into two classes, those to be stored at 32° F. to 34° F. and those to be stored at 40° F. to 45° F. Notes are given on tainting of one variety of fruit or vegetable by another in the store.

Further information can be obtained from the Officer in Charge (Dr. J. C. Fidler), Covent Garden Laboratory, D.S.I.R., 9-13, Kean Street, London, W.C. 2.

## A Goniometer cum Microscope

The Andhra Scientific Instruments Co., Masulipatam, has designed a new theodolite goniometer of a universal type of crystals at all possible orientations. An outline of the general features and the use of the instrument is given in an article appearing in the December issue of the *Journal of Scientific and Industrial Research (India)*. The main features of the instrument are (1) two circular scales, one in the horizontal and the other in vertical plane; (2) the crystal-holder, (3) the Collimator with illuminating arrangement, and (4) the telescope with a combination objective enabling its use as a low power microscope as well. The system is mounted on a rigid cast iron base provided with levelling screws for the adjustment of the scales exactly horizontal and the other vertical. The instrument is a self-contained unit provided with a low tension transformer feeding the illuminating system direct on the 220 volt A.C. mains. The instrument will be a valuable aid to X-ray specialists and crystallographers.

## National Institute of Sciences

Pandit Jawaharlal Nehru, the Prime Minister of the Indian Union, laid the Foundation Stone of the National Institute of Sciences of India on the 19th of April at New Delhi. Sir S. S. Bhatnagar, the President of the Institute, welcomed the Prime Minister on the occasion, and Pandit Nehru delivered an address before performing the ceremony.

## Training Colleges in Britain

The British Ministry of Education proposes to set up a chain of national training colleges for technologists, scientists and industrial research workers. The plan will be worked out by an important new Advisory Council on Education for Industry and Commerce, consisting of representatives of educational bodies, local authorities, employers and trade unions.

The Council will keep in close touch with the leaders of industry, science and universities and will have the task of co-ordinating the activities of the training establishments to ensure that full use is made of the nation's brains and technical skill. In addition, the Council will study the question of examinations and scholarships and will be entrusted with the task of seeing how training facilities and equipment can be improved to the fullest possible extent.

## ERRATUM

Volume 17. No. 3, March 1948, page 101, line 5: *Read* "variety did not seem to develop" *for* "variety did seem to develop", etc.

330 48 Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore

Current Science

Vol. XVII] MAY 1948 [No. 5



# CENTRAL LEATHER RESEARCH INSTITUTE*

THE idea of having this Institute at Madras was conceived as far back as in 1945, but for various reasons beyond our control it could not take a concrete shape earlier. In recognition of the great importance of leather industry in this country and with a view to furthering the study of and research in leather technology the Council of Scientific and Industrial Research has been making a block grant of Rs. 60,000 a year to the University of Madras, so that they could run a centre of leather research and technology in the University, which may ultimately develop into a full-fledged Research Association Laboratory. In a national endeavour of this nature, it is through the willing co-operation of one and all that success could be achieved. In our effort to establish this Institute, we have had the sympathy and support of the National Government at the Centre, the Government of Madras, the commercial community of India interested in leather trade and industry and the University of Madras. I wish to take this opportunity for thanking Shri C. Rajagopalachari, Shri T. Prakasam, Shri O. P. Ramaswamy Reddiar and Sir A. Lakshmanaswamy Mudaliar, for the invaluable help they have given us. The Government of Madras have promised to place at our disposal free of cost a site measuring about 200 acres and also to bear a part of the recurring expenditure of the proposed Institute. The industry has also promised to make contributions towards capital as well as recurring expenditure but the brunt of the burden will be borne by the Central Government through the Council of Scientific and Industrial Research.

The leather industry plays an important role in India's national economy. India has the largest herds of cattle in the world—about 180,000,000 cows and oxen, 50,000,000 buffaloes, 46,000,000 sheep, 58,000,000 goats and 12,000,000 of other kinds; and her estimated leather production which include 20 million cow hides, 5·7 million buffalo hides, 27·5 million goat skins and 17 million sheep skins, ranks the highest. The Indian Hides Cess Committee has valued the nation's normal production of raw leather at about 19 crore rupees with a present value, about twice this. Hides and skins, raw as well as tanned, form a big item in

* Extracts from a speech delivered at Madras by Sir Shanti Swarup Bhatnagar, Director, Scientific and Industrial Research, while requesting the Hon'ble Dr. Shyama Prasad Mookerji to lay the foundation-stone for the building of the Central Leather Research Institute on April 24, 1948.

India's export trade. As a result of partition approximately one-sixth of the bovine population and one-eighth of the goats and sheep are included in Pakistan area. The production of hides and skins will also be reduced roughly in the same ratio.

The province of Madras occupies a singular position in India's leather industry. Twenty per cent. of the cows, 25 per cent. of the buffaloes, 25 per cent. of the goats and more than half the total number of sheep in the whole of India are reckoned to be in this province. Madras is also rich in vegetable tanning materials such as *Tarwar* or *Avaram*, *Amalatas*, *Babul myrobolans*, *Mangroves*, *Divi divi*, etc. Recently wattle cultivation has also been introduced with good success, though it is not yet sufficient to meet the demand. The skill of the Madras tanner is world renowned, and the preparation of half-tanned hides is a unique speciality of his province. Ninety-five per cent. of hides and 85 per cent. of skins exported from India are sent out from Madras.

### Need for a Leather Research Institute in India

The Indian leather industry is still characterised by the two chief attributes of its past great tradition: (1) it has essentially remained a decentralised cottage industry in spite of the few big organised tanneries, and (2) it has continued to be a craft based more on empirical knowledge than on modern scientific methods.

We live in an age of science, and the modern leather industry owes a great deal to science; scientific methods are being applied to it to an ever-increasing extent effecting continual progress in the techniques of production. To develop and maintain the Indian leather industry in the forefront of progress demands, in the face of world-wide competition, ready access to new discoveries in science which are the raw material of all new development. This being so, a national research effort adequate to produce these basic discoveries must be there.

The leather industry in the West during the last fifty years has taken tremendous strides in manufacturing techniques as well as in the science of leather, and this was possible only through extensive and organised research. India, being the largest source of hides and skins in the entire world, has a natural right to play a leading part in this industry. All these years she was satisfied with merely exporting. It should now be realised that this is frittering away our national wealth. Research is said to be the handmaid of industrial progress, and in the case of the Indian leather industry advancement will be possible only through research.

Though there are at present leather trades institutes in the major provinces and States, they have primarily been training institutions for operator and foremen types of personnel for the leather industry and have not undertaken scientific research on a scale commensurate with the needs of the industry.

The Leather Research Committee of the Council of Scientific and Industrial Research, set up in 1944 at my suggestion, was the first attempt in this country to seriously examine the possibilities of planned and co-ordinated scientific research in leather manufacture, and on their recommendations the Council is financing leather research on a planned basis in several centres; the most important are the block grant of Rs. 60,000 per year to the Department of Leather Technology of the University of Madras and a grant for a five-year programme of work at the Bengal Tanning Institute, Calcutta. In order to develop the Leather Industry of India along modern lines and bring it on a level with the highly progressive leather industries of Europe and America this Committee recommended the early establishment of a Central Leather Research Institute.

### Leather Manufacturers' Research Association

The research-association idea is primarily to help the small firms; and the structure of the leather industry in India is such that a research association will benefit the entire industry. A research association is an organisation established under the Companies Act, for co-operative research by firms in an industry or a group of related industries. They appoint their own staff, make their own arrangements for carrying out research and draw up their own programmes according to requirements with the advice of the Government organisation. The following privileges are enjoyed by the members of a research association: (1) they can obtain technical information within the scope of the research organisation; (2) they can

recommend specific subjects for research and, on approval by the Government Body of the Association, have them investigated without further cost to the firm. The results are available to all members; (3) they can use any patent on secret process with or without nominal payment; and (4) they can ask for a specific research to be undertaken for their benefit at cost price.

The formation of research associations for Indian industries was first recommended by the Industrial Research Planning Committee which was presided over by Sri R. K. Shanmukham Chetty. The immediate constitution of such a research association of leather manufacturers was also recommended by the Leather Research Committee.

The Council of Scientific and Industrial Research approved in principle the proposals for the Central Leather Research Institute and the Leather Manufacturers' Research Association and decided that the Institute and the Research Association should be located in the Madras Province which is most vitally interested in this industry. At the instance of Shri C. Rajagopalachari, the then President of the Council of Scientific and Industrial Research, I visited Madras and inspected various sites in the vicinity of the capital city for the situation of the Institute and in consultation with the Minister for Industries, Madras, and the Vice-Chancellor, University of Madras, selected one near the Engineering College, Guindy. The Government of Madras has made a very generous free offer of the site for the Institute. The intention is to make this Institute function as the laboratory of the Research Association.

### Scope of the Institute

Hides and skins to be converted into leather have to go through the following general operations: soaking, liming, deliming, bating, pickling, tanning and finishing. These include a number of detailed operations making the whole process highly complicated. Each operation alters the skin physically as well as chemically; and chemical, bacterial and enzymic reactions, influenced by temperature, concentration, acidity or alkalinity, age of the liquors and period of treatment, play great part in these operations.

The chemistry of leather manufacture is so complex that in order to understand it one has to possess a good knowledge of chemistry, physics, bacteriology and physiology. Nowhere is the need for research so essential as it is in these complex processes, the full understanding of which still defies the scientist in spite of rapid advancements made during the last few years. The industry elsewhere has advanced rapidly by the application of scientific methods in controlling these processes, by introducing mechanised forms of production and by standardising the physical properties of leather required by the consumer by means of approved physical tests. Revolutionary changes have been introduced in the use of materials in liming, bating, tanning, dyeing, fat liquoring and other processes. Equipment and machines have been developed for operations such as unhairing, fleshing, scudding, drying and finishing.

Research as applied to the leather industry may be classified under the headings: (*i*) basic or fundamental research; (*ii*) applied research; and (*iii*) development research including pilot plant work.

The Indian leather industry has many pressing problems, big and small, upon which its future prosperity depends. Hitherto whatever progress was noticed it came from individual firms, but henceforth the Leather Research Institute will form the focus of all scientific activity of this industry.

## HIS EXCELLENCY LORD MOUNTBATTEN, VISITOR, INDIAN INSTITUTE OF SCIENCE

On Wednesday, the 28th April 1948, His Excellency Lord Louis Mountbatten, Governor-General of India, and Visitor of the Indian Institute of Science, accompanied by his daughter, spent about an hour in the premises of the Institute going round the several laboratories with Mr. E. V. Ganapathi Iyer, the Director.

Addressing the members of Staff and students of the Institute at the end of his visit, His Excellency referred to the importance of the work of the Institute for the scientific and industrial progress of the country and assured the members that the National Government were keenly conscious of the potentialities of science as a powerful factor in the development of the country and had been extremely enlightened and liberal in financing the several expansion schemes sponsored by the Governing Council. He expressed the hope that the department of Aeronautical Engineering which was one of the new departments of the Institute and had special scope for work in collaboration with the Hindustan Aircraft Factory, would make valuable contributions to the development of the aircraft industry in India.

India's export trade. As a result of partition approximately one-sixth of the bovine population and one-eighth of the goats and sheep are included in Pakistan area. The production of hides and skins will also be reduced roughly in the same ratio.

The province of Madras occupies a singular position in India's leather industry. Twenty per cent. of the cows, 25 per cent. of the buffaloes, 25 per cent. of the goats and more than half the total number of sheep in the whole of India are reckoned to be in this province. Madras is also rich in vegetable tanning materials such as *Tarwar* or *Avaram, Amalatas, Babul myrobolans, Mangroves, Divi divi,* etc. Recently wattle cultivation has also been introduced with good success, though it is not yet sufficient to meet the demand. The skill of the Madras tanner is world renowned, and the preparation of half-tanned hides is a unique speciality of his province. Ninety-five per cent. of hides and 85 per cent. of skins exported from India are sent out from Madras.

### Need for a Leather Research Institute in India

The Indian leather industry is still characterised by the two chief attributes of its past great tradition: (1) it has essentially remained a decentralised cottage industry in spite of the few big organised tanneries, and (2) it has continued to be a craft based more on empirical knowledge than on modern scientific methods.

We live in an age of science, and the modern leather industry owes a great deal to science; scientific methods are being applied to it to an ever-increasing extent effecting continual progress in the techniques of production. To develop and maintain the Indian leather industry in the forefront of progress demands, in the face of world-wide competition, ready access to new discoveries in science which are the raw material of all new development. This being so, a national research effort adequate to produce these basic discoveries must be there.

The leather industry in the West during the last fifty years has taken tremendous strides in manufacturing techniques as well as in the science of leather, and this was possible only through extensive and organised research. India, being the largest source of hides and skins in the entire world, has a natural right to play a leading part in this industry. All these years she was satisfied with merely exporting. It should now be realised that this is frittering away of national wealth. Research is said to be the handmaid of industrial progress, and in the case of the Indian leather industry advancement will be possible only through research.

Though there are at present leather trades institutes in the major provinces and States, they have primarily been training institutions for operator and foremen types of personnel for the leather industry and have not undertaken scientific research on a scale commensurate with the needs of the industry.

The Leather Research Committee of the Council of Scientific and Industrial Research, set up in 1944 at my suggestion, was the first attempt in this country to seriously examine the possibilities of planned and co-ordinated scientific research in leather manufacture, and on their recommendations the Council is financing leather research on a planned basis in several centres; the most important are the block grant of Rs. 60,000 per year to the Department of Leather Technology of the University of Madras and a grant for a five-year programme of work at the Bengal Tanning Institute, Calcutta. In order to develop the Leather Industry of India along modern lines and bring it on a level with the highly progressive leather industries of Europe and America this Committee recommended the early establishment of a Central Leather Research Institute.

### Leather Manufacturers' Research Association

The research-association idea is primarily to help the small firms; and the structure of the leather industry in India is such that a research association will benefit the entire industry. A research association is an organisation established under the Companies Act, for co-operative research by firms in an industry or a group of related industries. They appoint their own staff. make their own arrangements for carrying out research and draw up their own programmes according to requirements with the advice of the Government organisation. The following privileges are enjoyed by the members of a research association: (1) they can obtain technical information within the scope of the research organisation; (2) they can

recommend specific subjects for research and, on approval by the Government Body of the Association, have them investigated without further cost to the firm. The results are available to all members; (3) they can use any patent on secret process with or without nominal payment; and (4) they can ask for a specific research to be undertaken for their benefit at cost price.

The formation of research associations for Indian industries was first recommended by the Industrial Research Planning Committee which was presided over by Sri R. K. Shanmukham Chetty. The immediate constitution of such a research association of leather manufacturers was also recommended by the Leather Research Committee.

The Council of Scientific and Industrial Research approved in principle the proposals for the Central Leather Research Institute and the Leather Manufacturers' Research Association and decided that the Institute and the Research Association should be located in the Madras Province which is most vitally interested in this industry. At the instance of Shri C. Rajagopalachari, the then President of the Council of Scientific and Industrial Research, I visited Madras and inspected various sites in the vicinity of the capital city for the situation of the Institute and in consultation with the Minister for Industries, Madras, and the Vice-Chancellor, University of Madras, selected one near the Engineering College, Guindy. The Government of Madras has made a very generous free offer of the site for the Institute. The intention is to make this Institute function as the laboratory of the Research Association.

### Scope of the Institute

Hides and skins to be converted into leather have to go through the following general operations: soaking, liming, deliming, bating, pickling, tanning and finishing. These include a number of detailed operations making the whole process highly complicated. Each operation alters the skin physically as well as chemically; and chemical, bacterial and enzymic reactions, influenced by temperature, concentration, acidity or alkalinity, age of the liquors and period of treatment, play great part in these operations.

The chemistry of leather manufacture is so complex that in order to understand it one has to possess a good knowledge of chemistry, physics, bacteriology and physiology. Nowhere is the need for research so essential as it is in these complex processes, the full understanding of which still defies the scientist in spite of rapid advancements made during the last few years. The industry elsewhere has advanced rapidly by the application of scientific methods in controlling these processes, by introducing mechanised forms of production and by standardising the physical properties of leather required by the consumer by means of approved physical tests. Revolutionary changes have been introduced in the use of materials in liming, bating, tanning, dyeing, fat liquoring and other processes. Equipment and machines have been developed for operations such as unhairing, fleshing, scudding, drying and finishing.

Research as applied to the leather industry may be classified under the headings: (*i*) basic or fundamental research; (*ii*) applied research; and (*iii*) development research including pilot plant work.

The Indian leather industry has many pressing problems, big and small, upon which its future prosperity depends. Hitherto whatever progress was noticed it came from individual firms, but henceforth the Leather Research Institute will form the focus of all scientific activity of this industry.

---

## HIS EXCELLENCY LORD MOUNTBATTEN, VISITOR, INDIAN INSTITUTE OF SCIENCE

On Wednesday, the 28th April 1948, His Excellency Lord Louis Mountbatten, Governor-General of India, and Visitor of the Indian Institute of Science, accompanied by his daughter, spent about an hour in the premises of the Institute going round the several laboratories with Mr. E. V. Ganapathi Iyer, the Director.

Addressing the members of Staff and students of the Institute at the end of his visit, His Excellency referred to the importance of the work of the Institute for the scientific and industrial progress of the country and assured the members that the National Government were keenly conscious of the potentialities of science as a powerful factor in the development of the country and had been extremely enlightened and liberal in financing the several expansion schemes sponsored by the Governing Council. He expressed the hope that the department of Aeronautical Engineering which was one of the new departments of the Institute and had special scope for work in collaboration with the Hindustan Aircraft Factory, would make valuable contributions to the development of the aircraft industry in India.

# TROPICAL MEDICAL CONGRESS

*(Secretary of State George C. Marshall's Welcome Address)*

On behalf of the Government and the people of the United States, I welcome this distinguished gathering of scientists, physicians and public health officials to Washington. We are honoured to be host to your joint Congresses and the Department of State, along with other Government agencies and professional societies, is happy to sponsor your sessions.

Since your last meeting at Amsterdam in 1938, the world has passed through a terrible ordeal which threatened to cancel out the progress mankind had slowly and painfully achieved through centuries of sacrifice and toil. By a supreme effort civilization was saved and in the process new discoveries and inventions added to the store of man's accumulated knowledge. The human race has been given another opportunity to develop an enlightened and enduring world order. The vigorous reassertion of man's constructive talents, as exemplified by this gathering of delegates from 41 countries, is reassuring to our hopes for the future.

The concentration of some of the best minds and most zealous spirits of many lands on common objectives in these conferences is convincing evidence that our world is not a conglomeration of geographic entities but a vast neighbourhood of peoples. We can fly around the world now in less time than is required for the incubation of most diseases. In the modern world isolation in the medical sense is as impossible as political and economic isolation. There is no way we can escape the consequences of each other's mischief or misfortune. There is no acceptable alternative to learning to live together in harmony and well-being.

### Role of Medical Profession

The professions you represent are in the forefront of this great humane endeavour. Statesmen and men of affairs usually and unfortunately must deal with urgent, immediate problems—the effects, and not the causes, of the discords that mar human relationships. Seldom are we able to get at the remedy for the mass misery that develops discontent, misunderstanding and violence. That is your particular province, in which you labor as benefactors of mankind.

It would be a great gain if all the prosperous and the well-fed realized as well as you do that the overwhelming majority of the plain people of the earth are still primarily and necessarily concerned with the rudiments of life—enough food to eat, clothes to wear, decent shelter, and relief from hunger, pain and debilitating sickness. Until these fundamental needs are somehow met, the human race can never achieve the degree of development which is necessary to a peaceful contented world.

The conquest of diseases which hold millions weak and inefficient, the maximum production of foodstuffs on lands now yielding little are tremendously important requirements of the world situation. The tropical regions, in large measure, hold the key to both these necessary advances. They produce large quantities of materials required by the industrial areas of the temperate zones, but the potentials of the tropics largely remain to be developed. The tropical countries do import industrial products, but that market is only a fraction of what it might be.

### Conquest of Tropical Diseases Will Benefit World

The tropics are the habitation of perhaps half the human race, but a large portion of these people lack greatly in the advantages of modern civilization. A chief factor in restricting improvement in these respects is tropical disease. Little imagination is required to visualize the great increase in the production of food and raw materials, the stimulus to world trade, and above all, the improvement in living conditions, with consequent social and cultural advances, that would result from the conquest of tropical diseases.

This situation presents a challenge that, like the Equator, cuts across national boundaries and local interests. It is an international problem and it should be solved by a pooling of the genius and the resources of many nations. That it is not insoluble from the medical standpoint has been demonstrated by numerous projects with which you are familiar. The task of convincing the Governments and peoples most concerned of the feasibility of controlling and eventually eradicating disease throughout the tropics will be measurably advanced by the discussions at this conference of the latest discoveries of resarch and the modern techniques in public health.

The achievements and the aims of the co-operative effort represented by these meetings emphasize anew that, man has so far more to gain by uniting in a common fight against his real enemies, such as disease, than by internecine strife on his own kind.

This spirit of generous co-operation for the common good, I am sure, will permeate all your meetings and will assure the notable success which I and my fellow American wish for your joint Congresses.

—*USIS.*

# THE SPIKE DISEASE OF SANDAL

M. SREENIVASAYA
(*Indian Institute of Science, Bangalore*)

## HOST PLANT, THE FUNDAMENTAL CENTRE OF INTEREST

THE sandal plant is influenced by its associated host plants with regard to its (*a*) growth, (*b*) seeding, (*c*) heartwood formation and (*d*) resistance to insect attack and spike disease.

Experimental and ecological evidence has been obtained to support the view that at no stage of its life can the sandal plant afford an independent existence with a normal functioning of all the above physiological activities.

The associated host plants, therefore, constitute the fundamental centre of interest, whatever be the line of approach, particularly in a study of the problem of spike disease.

It is well known that, generally, the physiological condition of the plant determines its predisposition to disease or insect attack, and this condition, in the case of the parasitic sandal, has been found to be influenced by its host plants.

The variety and quantity of insect fauna infecting a sandal, therefore, depends upon the floristic composition of the host group nourishing the plant.

## SPECIFICITY OF ASSOCIATION OF INSECTS IN RELATION TO SPECIFIC HOST-SANDAL COMBINATION

Entomological collections of Mr. Chatterjee lend support to the above statement. The specificity of association of certain species of insects with certain definite host-sandal combinations has been established.

The practical significance of this discovery is realized if attention is called to the fact that the composition of the sap of sandal could be controlled through a judicious choice of host plants so as to render the sap distasteful or repulsive to certain classes of insects and possibly to vectors of disease, yet conclusively undetermined.

## TYPES OF IMMUNITY

Disease-transmission studies under controlled conditions have revealed the existence of two types of resistance among sandal plants—(*a*) Autogenic resistance exhibited by certain plants which is largely independent of the nature of the associated host plant, (*b*) Acquired resistance, built up by the sandal if certain species of hosts and certain conditions of environment are provided.

Ecological evidence also lends support to the existence of both types of sandal plants. Strains of sandal inherently resistant to disease are often encountered in heavily-spiked areas, and with regard to the other type of resistance, floristic surveys have shown that the incidence and spread of disease is dependent upon the floristic composition of the area.

The discovery of these factors of disease-resistance among sandal plants constitutes an advance of great practical importance, as these facts are helpful in the establishment of sandal forests with resistant stock, reinforced by hosts known to impart immunity to sandal.

Two such areas have already been started in North Salem.

## HAUSTORISING CAPACITY—A GUIDE TO RESISTANCE

The property of autogenic resistance has been correlated with a high haustorising capacity and a comparatively large root system in the seedling stage of the sandal, thus affording a useful and practical guide to the selection of resistant strains. Attempts are now being made to discover a simpler morphological index easily recognisable in the seed itself.

Among the host plants through which sandal acquires relative immunity, are *Cassia siamia*, *Casuarina*, *Melia indica*, *Murraya*, *Koenigii*, *Dudonea viscosa*, *Semicarpus aancardium*, *Ficus bengalensis*, *Sarcostemma breristigna*, *Ruta graveloens*.

## RESISTANT AND SUSCEPTIBLE HOSTS

Among the host plants which have been found to render sandal particularly susceptible to disease are *Acacias* in general, *Pongamia glabra*, *Lantana camara*, *Cajanus indicus*, *Divi divi*, *Ocimum sanctum*.

It is obvious that the flora associated with sandal areas could be divided into two groups: (1) those which impart disease resistance to sandal and (2) those which render it susceptible to disease. This classification can be based either upon (1) direct experimental evidence or (2) indirect evidence based on ecological surveys.

The practical knowledge gained through both these sources has been utilised in the opening of regeneration plots in North Salem. Confirmation of the "susceptible" character of *Pongamia* and *Cajanus indicus* has already been obtained under sylvicultural conditions at Javalgiri.

### Artificial Transmission

Artificial disease transmission through grafts constitutes an extreme type of infection, and a plant resistant to this operation would naturally tend to approach a strain possessing perfect and unqualified immunity. In the course of transmission studies, several such types have been obtained and these have been utilised for stocking an area at Javalgiri.

Grafts do not always take; organic fusion of the graft with the operated stock is necessary for effective transmission of disease. Sometimes the disease does not manifest itself in spite of intimate fusion, sometimes the graft is unsuccessful and in yet other instances the graft is thrown out by vigorous callous formation.

### Resistance to Grafting in Relaltion to Environment

These laboratory findings have found confirmation under sylvicultural conditions. At Javalgiri about 80 per cent. success was obtained with regard to disease-transmission through grafts, while two similar operations at Mahadeswarangudi area have resulted in a complete failure of infection. The explanation to this remarkable and encouraging phenomenon is to be sought in the strikingly different floristic aspects presented by those two areas. Grafting under sylvicultural conditions, therefore, affords a useful technique for determining the susceptibility or resistance offered by environment to disease.

### Root System of Host in Relation to Disease-Resistance

Among the other factors of environment which predispose sandal to disease, depth and extensiveness of the root system of the associated host play an important part.

Pot-culture studies have shown that, with a given sandal-host combination at any given age, the plants growing in bigger pots are more resistant to disease than those in smaller ones: the greater the volume of soil commandeered by the root system, the greater will be the nutrition made available to the parasite sandal.

The root system of the host plant which is parasitised by sandal may be looked upon as an extension of the root system of sandal itself. Deep-rooted hosts, in general, are beneficial to the parasite, not only with regard to its growth but also in building up immunity to spike.

The soil profile studies which have been made in this connection have revealed that spike areas are characterised by a poor root system both as regards depth and intensity.

In the choice of host plants for sandal, preference should be given to those species which possess deep and extensive root systems.

### Sandal Itself, a Powerful Denuding Agent

In this connection the effect of sandal in restricting the regeneration of the root system of the host plant, has to be considered. This effect becomes pronounced when the parasitism on the host is heavy. In other words, the importance of recognising sandal as a powerful denuding agent is apparent.

Observations show that the primary attacks of spike have always occurred in places where the sandal stock is thickest and where the major hosts are either dead or dying. Over-parasitism should, therefore, be strictly avoided in the sylviculture of sandal. Regeneration of the parasite should be controlled and a judicious thinning of sandal, having regard to the availability of host plants, should be worked upon as a recognised sylvicultural practice. Other plant parasites in the area should be systematically eliminated, since their presence would tax the nutritional resources of the environment.

### Parasitised Hosts do not Stand Coppicing

Pot-culture studies have shown that sandal plants, when deprived of their host plants, succumb to the disease quicker. Host plants, parasitised by sandal on coppicing, rarely, if ever, put forth shoots. Field observations at Nognoor and Thalli points to the same conclusion.

These observations have a pertinent bearing on the sylviculture of sandal. No exploitation involving the deprival or weakening of host plants should be encouraged in sandal-bearing areas. All the host resources of the area should be conserved and consolidated for the vigorous and healthy growth of the parasitic sandal.

### Masking of Disease

Experimental transmissions have shown that a sandal plant kept continuously under shade is more susceptible to disease than a corresponding one kept exposed to the sun. The "shade" plants take on grafts with a higher percentage of success and succumb to the disease in greater numbers. This lends experimental support to the observations of Rao Bahadur K. R. Venkataraman Ayyar who has always held that plants "under suppression" are predisposed if not actually infected. On exposure to the sun, these plants manifest the disease symptoms;

and the "shade" plants grafted with disease tissue behave in essentially the same manner with the bursting of new buds in response to the stimulus of sunshine.

"Suppression" or "shading" of young sandal should, therefore, be strictly avoided in the sylviculture of sandal.

In the course of transmission studies, it has been found that some sandal plants mask the symptoms of disease for long periods. In such cases defoliation of the plant has helped in forcing out the symptoms of spike. The plant, during the period of "mask", puts on girth and height.

Under sylvicultural conditions also this phenomenon of masking has been observed. In every infected area dozens of such plants may be found; in Manchi, for example, about 20 per cent. of the stock in the area were found to have been already infected.

### Pollarding, an Important Technique to Force Out Symptoms

Sandal plants which thus mask the symptoms, constitute the sources of infection, since it has been shown by experiment that the disease can be transmitted to other healthy sandal plants by grafting some of their tissues.

Eradication of "spike" would not, therefore, be complete unless such sandal plants masking the disease are also eliminated. Non-removal of such apparently healthy sandal plants has been mainly responsible for the successive recrudescence of disease in an area, often in epidemic proportions.

In any scheme of eradication of spike, therefore, it is essential that pollarding should be adopted as a means of detecting "masking" trees. In the Manchi and Galigattam spike areas, this useful technique has been put into operation.

### Disease Localised and Ringing Prevents Further Spread

Laboratory experiments have shown that the disease is localised in the initial stages of infection and that the transport of the casual entity to other parts of the plant from the site of infection is slow. Ringing at the right place and at the right time will prevent the spread of disease to other organs of the plant and save the tree from spiking.

The practical application of this information in the control of spike is limited by the fact that under sylvicultural conditions one does not know the site of infection.

During the operation of pollarding, however, it is possible that fortuitous decapitation of virus-infected branches may lead to elimination of infective organs and save the rest of the plant.

### Season of Infection

It has been definitely ascertained that the actual infection occurs during April and May, which corresponds with the period when scars and other injuries are intensively inflicted on the sandal plant through some agency yet undetermined.

### Season of External Manifestation of Symptoms

The symptoms of spike tend to manifest themselves on infected sandal plants during the season which corresponds with the vegetating period of sandal. In April, May and June, under the stimuli of moist-heat and sunshine, the disease manifests itself with the growth of the new flush from the dormant buds.

This information is very useful in fixing the season during which a vigilant watch has to be kept over sandal-bearing areas when fresh attacks may be expected in large numbers.

### Shift of Season

Shift in the season of maximum disease incidence, may occur due to natural causes, which result in forcing out new flush in sandal plants. Forest fires and browzing by herds are the two main causes which effectively alters the period. The season during which fires occur is known to forest officers, and soon after its occurrence the epidemic should be looked for.

### Primary Attacks Associated with Denuded Spots

Primary site of attack, so far as our present observations indicate, are characterised by marked changes in floristic composition, the change always accounting to a degradation towards the scrub xerophytic type of vegetation.

Deep-rooted species are replaced by shallow rooted and deciduous shrubs of the lantana type, thus rendering moisture and nutrients from deeper layers unavailable to sandal.

This degradation is often found to be the combined result of exploitation, fire, over parasitism, grazing and other denuding factors.

Effective measures for the protection of these denuding agents, should be laid down and rigidly enforced.

### Lantana and Spike Disease

The frequent association of lantana with spike trees has led us to believe that it has some relation with spike disease. Laboratory experiments have shown that lantana is one

of the plants which renders sandal susceptible to disease. The more serious aspect of lantana is its aggressive spread with the gradual elimination of all useful species in the area. Its growth renders the soil toxic to most other plants which die in course of time. The ease with which lantana catches fire during the hot weather renders it a dangerous source of combustible material, and consequently the cause of frequent fires which accelerate the denudation of the area. Bird-life becomes scarce in lantana areas which proportionately encourages an abundance of insect fauna and possibly an increase in the concentration of the vectors of spike disease.

Elimination of lantana is a problem of great importance not only from the point of view of spike disease but also from the view-point of general sylviculture.

### Elimination of Lantana Effects Remarkable Ecological Changes

It has been found that keeping down lantana artificially has a marked influence on reducing the incidence of disease, as found in Cairn No. 53, Observation area. This fact is due to the circumstance that continual weeding out of lantana has enabled other beneficial species to come up, and the ecological change that has been effected in the area during a period of seven years was remarkable.

The survey has revealed that, out of the 57 species of plants occurring in the lantana-free area, 21 are exclusive to the plot and are entirely absent from the lantana-infested area ; with regard to the other species occurring in both plots, they decidedly preponderate in the lantana-free area, where one cannot fail to notice that the plot has been well stocked not only with sandal but also with host trees.

This is a striking instance where, through human effort, a restoration of the deciduous high forest type of vegetation has been effected through the simple operation of weeding out lantana and the practical bearing of this fact on the control of spike disease is quite obvious.

### Haustorial Spread of Disease not a Serious Factor

Effective artificial transmissions through haustoria so far achieved does not exceed 8 per cent., and, therefore, under sylvicultural conditions the spread of disease through roots is possibly very small. The secondary spread of disease is in consequence largely effected above ground through some agency, yet to be identified.

In the practical control of disease, therefore, factors operating above ground demand relatively more serious consideration.

### Arsenical Preparations to Combat Spike

Effective removal of the sources of infection should be the immediate objective so far as diseased areas are concerned. Application of Atlas and other arsenical preparations as prescribed by Dr. A. V. V. Iyengar, have been found to be most effective agents in rendering the causal entity in the entire plant innocuous. The arsenic does not appear to interfere with the valued essential oil in the heartwood.

### Scars, a Measure of Disease Incidence

In the absence of any statistical information ragarding the relative abundance of insect fauna in the various observation areas, a study of the scars has been helpful in obtaining a comparative idea of their existence or activity with respect to sandal. Results indicate that the intensity of attack on sandal, as measured by scars, is roughly proportional to disease incidence.

### A Practical Scheme for Disease Control

Methods of disease control are necessarily preventive in nature, since there has been, so far, no instance of a plant recovering from spike. The root stimulation and injection experiments which were in the main intended to cure the disease, gave negative results. Even if a certain constituent should, in the course of future investigations, prove an effective cure for the disease, the practical application of the discovery would be beset with insurmountable difficulties. It would be well nigh impossible to deal with every diseased sandal plant by injecting the chemical, when large areas of spike as obtained in practice are encountered.

In considering methods of prevention, we have to take cognizance of the fact that the sandal occurs in widely scattered areas and grows under different conditions. The methods of control in consequence will have to be modified in accordance with the nature of the area. The following is an attempt at classification of sandal areas from a sylvicultural point of view.

In devising methods of prevention and remedy the following five kinds of sandal-bearing areas merit consideration :—

(*a*) What are the precautionary measures to be adopted in healthy areas, at present, far removed from sources of infection ?

(*b*) By what methods can we prevent a

further spread of spike into healthy areas which happen to lie in close proximity to sources of infection?

(c) What are the operations necessary to prevent a predisposed area from succumbing to disease?

(d) What is the most effective and economical method of dealing with spiked areas?

(e) What is the best way of regenerating new sandal areas, which will ensure its freedom from "spike"?

Attention has been called to the fact that the primary sites of attack are always associated with denuded areas where a visible change in floristic coposition is effected. Prevention of this change would naturally constitute the best means of protecting healthy areas. Among the denuding factors which should be prevented from operating in any of the sandal areas, are :—

(1) Over-parasitisation due to a disproportionate regeneration and growth of sandal to be checked by judicious thinning.

(2) Other plant parasites of no economic value like loranthus, viscum, opilia, etc., which should be systematically eliminated from the area. These parasites as indicated before, deplete the nutritional resources of the environment.

(3) Exploitation of timber and fuel from sandal-bearing areas should either be totally avoided or scientifically controlled.

(4) All possible recognised methods of fire control should be rigidly enforced.

(5) Lantana and other aggressive weeds should be kept down, and open areas which might be invaded by these species may be planted up with some useful species.

(6) All species showing symptoms of 'spike', *e.g., Z. œnoplia, Dudonea viscosa, Jasminium,* etc., should be promptly weeded out.

Other predisposing factors which have also a bearing on the sylviculture of sandal should be eliminated and the sandal plants should be enabled to build up resistance to disease. In this conection, the following suggestions are offered :—

(1) If afforestation of the area is contemplated, deep-rooted and "resistant" host plants, indigenous to the country, may be introduced into the area.

(2) "Shading" or suppression of sandal plants should be strictly avoided.

The above suggestions apply particularly to (*a*) and (*b*).

With regard to (*c*), where the ecological change has already been initiated or completed, a reversal of the conditions to the original state constitutes the most rational means of checking the incidence and spread of spike.

The main problem in such an area would involve :—

(1) The elimination of lantana and other shallow-rooted and aggressive species invading the area;

(2) the encouragement of the deep-rooted indigenous species to come up either naturally or through sowings. In this connection, attention may be called to the remarkable ecological change that has been artificially brought about in Cairn No. 53 at Javalgiri;

(3) a partial thinning of sandal plants may be effected to reduce the sandal-host ratio and to cut down competition for the available nutriment in the area;

(4) "spike"-bearing weeds should be systematically eliminated;

(5) fire protection, which might otherwise lead to further degradation of the area, should be enforced;

(6) in the case of sandal plants which look predisposed or suspicious, masked symptoms should be forced out by pollarding the tree. If, subsequently, the plant remains healthy, it would establish that the area is free from disease; if, on the other hand, the plant manifests the disease symptoms, it is always safe to assume that every sandal in the area is infected. A wholesale pollarding should generally be adopted as a routine.

Areas coming under the group (*d*), should first be treated in the following manner :—

(1) Immediate effective elimination of 'Spike' plants should be the first operation. The application of arsenical preparation have been very useful in this connection.

(2) Other sources of infection like (*a*) 'masked' sandal trees, (*b*) weeds suffering from spike and (*c*) the viruliferous vectors whose existence has been suspected but not experimentally established, should be considered.

The area may be then treated in exactly the same manner as if it were (*c*).

---

*Note.*—The cost of printing this article has been met from a generous grant received from the National Institute of Sciences, India.

# PIPRI RIHAND DAM MULTI-PURPOSE PROJECT, UNITED PROVINCES, INDIA

THIS is one of the great multi-purpose schemes to be soon undertaken in India, by the U.P. Government. This contemplates the harnessing of the river Rihand which is a tributary of the great Sone River and aims at producing 2·2 lakh kilowatts of electric power by impounding the colossal volume of 400,000,000,000 cubic feet of water with a concrete gravity Dam across the "Rihand" river at Pipri, about 3,085 ft. in length and 300 ft. in height. The Dam site and section have been approved by Dr. Savage, Chief Designer of the famous T.V.A. scheme of America. The total cost of the Project is estimated to be 16 crores, and the cost per unit of power generated is anticipated to be only 1·3 pies, a figure unsurpassed anywhere in the world except in case of a few schemes in Sweden, Norway and Canada, where Nature is particularly generous.

For generation of Power at Pipri a minimum flow of 6,000 cusecs. will be maintained in the river all the year round which would irrigate lakhs of acres in the neighbouring province of Bihar. This minimum flow throughout the year will, therefore, admit of inland navigation for cheap transport from Calcutta right up to the border of the Rewa State, close to which the power is generated on the same lines as in the American T.V.A. scheme. The construction of the huge reservoir will also serve to moderate the intensity and frequency of floods in the region. The generation of power would be at a site in U.P. which is near the borders of Bihar, Orissa and the Rewa State. The power transmission lines could thus be linked up by a grid with those for power to be generated in the Damodar Valley of Bihar and the Hirakud Dam scheme of Orissa, the foundation stone of which was laid a few days ago by the Prime Minister of India. The power generated at Pipri is to be mainly utilised for the purpose of industrial, agricultural and domestic consumption in the neighbouring districts of U.P. and a part also in the Rewa State. This huge scheme will thus give an immense impetus to great industrial and agricultural expansion schemes in this backward region of India.

K. D. JOSHI.

---

# INTERNATIONAL BUREAU OF PHYSICO-CHEMICAL STANDARDS

AT the request of "UNESCO" and by agreement with the International Union of Chemistry, the International Bureau of Physico-Chemical Standards of Brussels has accepted the task of establishing a collection of pure chemical substances of every kind (metals, alloys, mineral and organic substances, plastics, samples of biological interest, etc.) to place them at the disposal of laboratories and research workers of all countries, so as to enable them to control the nature and the purity of their own samples, or for any other research work.

The expenses for conservation, manipulation and distribution of the samples will be met by a subsidy from "UNESCO". But to constitute the collection, it has been decided to make an appeal all over the world, requesting the laboratories and the research chemists who have prepared or have at their disposal such substances in a state of sufficient purity to send a sample to the new centre thus created for the common interest of all men of science; to the sample should be attached a concise notice showing its method of preparation and purification, as well as its principal constants. However, please do not send any sample to Brussels, without first getting in touch with the International Bureau of Physico-Chemical Standards.

There may be cases, when the author of an original research wishes to keep for himself the sample of the substance he has prepared. In this case it would be of great help if he would give us a description of the sample with its constants, so as to enable us to establish a register showing where one could eventually obtain these substances.

It must be well understood that this institution, purely scientific in character, wishes in no way to compete with the chemical industry, and that products easily obtainable on the market fall outside our scope. Nevertheless, some research laboratories of the chemical industries possess samples of rare substances, prepared for their own use in small quantities, and which, therefore, are not included in the catalogues of industrial and commercial firms. Such laboratories could also render a great service to science if they were willing to play their part in the realisation of our project.

We hope that this appeal will find a large response all over the world so that the international solidarity of men of science shall manifest itself once more.

For more detailed information please write to the Director of the International Bureau of Physico-Chemical Standards, Professor J. Timmermans, Universite Libre de Bruxelles, 50 Avenue Franklin Roosevelt, Bruxelles, Belgium.

## PROF. P. S. MACMAHON

BY a strange perversity of fate the two important national organisations, the Indian National Congress and the Indian Science Congress, owe their origin to the far-sighted vision of a few disinterested Englishmen. A. O. Hume, Lord Dufferin, Sir William Wedderburn and Sir Henry Cotton are credited to have laid the foundation for the first, while Profs. MacMahon and Simonsen were entirely responsible for the second. The Science Congress had attained its independence almost from its birth even though it had to be nursed by official patronage through its childhood. In its adolescence and manhood it has attained such a stature, and everything concerning it is taken so much for granted that its parenthood is almost forgotten. This is perhaps due to the extremely unassuming personality of the real parent, Prof. MacMahon, who, once he was satisfied that this child of his creation was growing fast and did not need his support any longer, kept himself completely in the background, so that many of his old friends and colleagues of the Science Congress have to be reminded that he is still in India. MacMahon always avoided the lime light. On April 30, 1948, he retired from service as Professor of Chemistry, Lucknow University, and as Public Analyst to Government of the United Provinces.

MacMahon had a brilliant academic career in Manchester University, after which he proceeded to Oxford where he carried out his classical work on the photochemical reactions between hydrogen and chlorine with Chapman. In 1910 he came to India as Professor of Chemistry in the Canning College, Lucknow, which was then an affiliated college of the Allahabad University. At about the same time J. L. Simonsen was Professor of Chemistry in the Presidency College, Madras. Both felt the absence of a scientific atmosphere and wished to start an association in India on the same lines as the British Association for the Advancement of Science. All the spadework was done by MacMahon, and it took him nearly three years to arrange for the first session of the Indian Science Congress, which was held in 1914 at Calcutta under the presidentship of Sir Ashutosh Mukerji. The Congress started with six sections, *viz.*, Chemistry, Physics, Geology, Zoology, Botany and Ethnography, while the total number of papers read were 35. In 1938, at the Jubilee Session, there were 13 sections and more than 800 papers besides general lectures and joint meetings.

Another important institution for which MacMahon is entirely responsible for its initiation and development is the Department of the Public Analyst in the United Provinces. This is a Government Department of which Professor MacMahon continued to be the Head on a part-time basis until his retirement.

When the Canning College was taken over by the newly created Lucknow University in 1921, MacMahon was appointed Head of the Chemistry Department. He was then able to persuade the authorities to reorganise chemistry teaching for which a beautiful new laboratory was built in 1929 to cater to the needs of students up to M.Sc. standard. He was unable to obtain enough funds for its proper equipment for research. The systematic financial starvation of the Universities by the Government is entirely responsible for this state of affairs. MacMahon had visited all important laboratories in England and the Continent, and knew what was needed; but it was his regret that he was unable to translate his ideas into practice with regard to the equipment of the Lucknow University laboratories for research work.

He has travelled widely, and is an extremely genial person and a perfect gentleman. He is a bachelor. He is leaving India after 38 years of meritorious service. He will be very much missed by his numerous friends, colleagues and students at Lucknow. We wish him many years of happy and peaceful life in his retirement.

M. R. N.

## GEOMAGNETIC STORMS

Some details of the geomagnetic storms as recorded at the Alibag Magnetic Observatory are given in the following table in which $t_0$, $t$ represent the time (I.S.T.) of commencement of the disturbance and its intense phase respectively, and T the duration of the intense phase expressed in hours. The ranges in the three different elements (D, H and V) of the earth's magnetic field have also been given, D, in minutes of arc, H and V in $\gamma$ where $1\gamma = 10^{-5}$ gauss. The maximum $k$-indices ($K_M$) recorded during the disturbances have also been given.

| Date | $t_0$ | $t$ | T | Range | | | $K_M$ | Nature of commencement |
|---|---|---|---|---|---|---|---|---|
| | | | | D | H | V | | |
| 1948— | h. m | h. m | hrs | Min. | | | | |
| Jan. 3 | 11 30 | 16 — | $8\frac{1}{2}$ | 2·4 | 185 | 27 | 5 | Gradual |
| Jan. 17 | 14 — | 17 30 | 3 | 3·2 | 183 | 30 | 7 | Gradual |
| Feb. 3–4 | 07 36 | 12 — | 7 | 4·7 | 197 | 34 | 5 | Sudden |
| March 12–15 | 03 08 | .. | 5 | 4·1 | 180 | 40 | 5 | Sudden |
| March 15 | 09 04 | 09 04 | 17 | 3·5 | 213 | 54 | 6 | Sudden |

# LETTERS TO THE EDITOR



## HEAT CONDUCTIVITY AND MOLECULAR WEIGHT OF LIQUIDS

THE author[1] has shown previously, after Osida,[2] that the heat conductivity of a *dielectric* liquid is determined *inter alia* by the vibration frequency of its molecules. The frequency of vibration of a particle, executing monochromatic vibrations about its position of equilibrium in a space lattice, varies inversely as the square root of its mass.[3,4] It is of interest to find out, therefore, whether any such relationship exists between the coefficient of heat conductivity, K, and the molecular weight, M, of a liquid.

K varies with temperature, *t*.[5-7] It is necessary, therefore, for the above investigation, to accumulate data on K for different liquids at a corresponding temperature, *e.g.*, the boiling point. Further, since various methods of measurement of K give slightly different values, data obtained by any single method are only strictly valid. Measurement of K at the boiling point is not possible. The heat conductivity at the boiling point $K_{B.P.}$ for a particular liquid can, however, be obtained from values at two (different) temperatures, assuming a linear relationship between K and *t*. In the accompanying table are shown the boiling points (B.P.), M, $\sqrt{M}$, $K_{B.P.}$ (obtained from Bridgman's data[6] at 30° and 75° C.) and $K_{B.P.}\sqrt{M}$ for twelve different liquids of widely varying M and K. The molecular weights M are those of the vapours.

As will be evident from the last column in the table, the product $K_{B.P.}\sqrt{M}$ is approximately a constant, except in the case of water. It has a mean value of 0·0030 for eleven liquids with M and $K_{B.P.}$ varying respectively from 32·0 to 156 and 0·000496 to 0·000261. That the heat conductivity of a liquid, like the frequency of vibration of its particles, should be an inverse function of the square root of its molecular mass is significant. The departure of water from this simple generalization requires further investigation.

| Liquid | M | $\sqrt{M}$ | B.P. (° C.) | $K_{B.P.} \times 10^3$ | $K_{B.P.}\sqrt{M}$ |
|---|---|---|---|---|---|
| Water .. | 18·0 | 4·243 | 100 | 1·595 | (0·006769) |
| Methyl alcohol .. | 32·0 | 5·657 | 64·7 | 0·496 | 0·002805 |
| Ethyl alcohol .. | 46·1 | 6·790 | 78·3 | 0·415 | 0·002818 |
| Acetone .. | 58·1 | 7·622 | 56·5 | 0·414 | 0·003156 |
| Isopropyl alcohol | 60·1 | 7·752 | 82·2 | 0·362 | 0·002806 |
| Normal pentane .. | 72·1 | 8·491 | 36·2 | 0·319 | 0·002709 |
| Ether .. | 74·1 | 8·608 | 34·6 | 0·328 | 0·002823 |
| Normal butyl alcohol | 74·1 | 8·608 | 117·5 | 0·383 | 0·003297 |
| Carbon disulphide | 76·1 | 8·724 | 46·2 | 0·375 | 0·003271 |
| Isoamyl alcohol .. | 88·1 | 9·386 | 131 | 0·341 | 0·003201 |
| Ethyl bromide .. | 109 | 10·44 | 38·4 | 0·284 | 0·002965 |
| Ethyl iodide .. | 156 | 12·49 | 72·3 | 0·261 | 0·003260 |
| | | | | Mean | 0·003010 |

My thanks are due to Prof. S. S. Joshi for his kind interest in the work.

Department of Chemistry,
Benares Hindu University,
*March* 15, 1948. S. R. Mohanty.

1. Mohanty, *Curr. Sci.*, 1947, **16**, 55. 2. Osida, *Proc. Phys. Math Soc. Japan*, 1939 **21**, 353. 3. Einstein, *Ann. der Phys.*, 1911, **34**, 170, 590; **35**, 679. 4. Lindemann, *Phys. Zeits*, 1910, **11**, 609. 5. Lees, *Phil. Trans. Roy. Soc.*, 1898, **191**, 399. 6. Bridgman, *Proc. Amer. Acad.*, 1923, **59**, 141. 7. Jakob, *Ann. der Phys.*, 1920, **63**, 537.

## A NOTE ON THE OCCURRENCE OF FREE SULPHUR IN DRUSES AND CAVITIES IN THE MICA-BEARING PEGMATITES OF GOSAVID, TIRUVUR TALUK

During recent field work in the mica-bearing regions of Tiruvur Taluk (Kistna District) an interesting occurrence of free sulphur in druses and cavities was noticed in a pegmatite vein near Gosavid, a village which is about 13 miles from Yerrupalayam Railway station on N.S. Rly. The country rocks of the area are khondalites consisting of garnetiferous-sillimanite gneisses, mica-schists, and quartzites into which are intruded charnockites, granites, and pegmatites. The pegmatites which are intrusive into the schists are disposed parallel to the plane of foliation of the latter. They carry workable mica and have been trenched by prospectors in a number of places. A zone of narrow central quartz core is surrounded on either side by a zone of felspar in the pegmatite, and in the quartz are a number of small drusy cavities. In some of the druses a yellow powder having the smell of sulphur was observed. On closer examination it proved to be sulphur in the free state. This powder was filling the druses which were up to an inch in width and up to half an inch in depth.

So far as we are aware, free sulphur has not been reported from any of the Indian pegmatites. The minerals comprising the pegmatites are quartz, felspar, muscovite, biotite, apatite, tourmaline and chalcopyrite. Chalcopyrite is very subordinate and occurs as sporadic stringers in the associated quartz.

The occurrence of free sulphur in a pegmatite is peculiar, and is of great academic interest. The trench was under excavation during the period of the survey of the area. No gun powder or dynamite were used for opening out the trenches and the excavation was done entirely with crowbars and wedges. The pegmatite vein up to this deposit was disintegrated and blocks of the vein material could be easily dislodged and removed without blasting. The druses with free sulphur occur at a depth of about 25 feet from the surface and in the zone of vadose circulation. Chalcopyrite stringers and lenses occur within about a foot from these druses.

One possibility which suggests itself is to consider this occurrence of sulphur as having been deposited as a sublimate in pneumatolysis. The association of chalcopyrite in close proximity is significant, as it points to the presence of sulphides in the emanations. Since, however, the sulphur was found within the limits of meteoric circulation in a vein which was highly fractured and disintegrated, the possibility of its having been derived from chemico-organic decomposition of the chalcopyrite cannot be ignored. Alteration of sulphide minerals by meteoric water is too well known to require elaboration. In a recent paper Schouten[1] recognises the possibility of the role of special bacteria in the reduction of sulphur-bearing minerals. It is conceivable that the chalcopyrite might have undergone oxidation by meteoric waters to a sulphate, and sulphur-reducing bacteria might have altered it to free sulphur, the possibility of which is indicated by Schouten,[1] Ganapathi[2] and Iya and Sreenivasaya.[3] If chemico-organic origin of this sulphur is admitted, it is not improbable that the druses were themselves originally filled with chalcopyrite. The main purpose of this note is to record the occurrence of free sulphur in mica-bearing pegmatites of Gosavid, Tiruvur Taluk. Alternative suggestions have been put forward to account for their origin.

Andhra University,
Geology Dept., C. Mahadevan.
Waltair, N. Gopalakrishnamurthy.
*March* 29, 1948.

1. Schouten, C., 1946, *Econ. Geo.*, 1946, **41**, 517. 2. Ganapati, S. V., *Proc. Ind. Acad. Sci.*, 1941, **12**, B. 283. 2 Iya, K. K., and Sreenivasaya, M., *Curr. Sci.*, 1944, **13**, 316; 1945, **14**, 243, 276.

## SYNTHESIS OF $\beta\beta$-DIMETHYL, $\beta\beta$-DIETHYL ADIPIC AND CYCLOHEXANE AND CYCLOPENTANE-1-ACETIC-1-PROPIONIC ACIDS

Bayer's strain theory suggests, under conditions, where glutaric and $\beta$-substituted glutaric acids yielded a cyclopropane ring, the adipic and corresponding substituted adipic acids should facilitate the formation of cyclobutane ring; but Thorpe Ingold valency deflection hypothesis points to the contrary. The present investigation was undertaken with the idea of verification of either view, which field remained unexplored, for the synthesis of such substituted adipic acids was attended with considerable difficulty. The usual methods for the conversion of a lower dibasic acid into a higher one fail when applied for the preparation of substituted adipic acids. It was, therefore, proposed that attempts to introduce a methylene group in one of the free arm chains carrying carboxyl groups in glutaric acid ($\beta$-substituted), be made. A method was devised on the lines, based on the conversion of ortho-nitrobenzonic acid into orthonitrophenyl acetamide,[1] and experiments were started to convert (*a*) $\beta\beta$ dimethyl, (*b*) $\beta\beta$ diethyl glutaric acids into corresponding adipic acids and (*c*) cyclohexane, (*d*) cyclopentane-1-1-acetic acids into corresponding · cyclohexane cyclopentane-1-acetic-1-propionic acids. The acids

(a) and (b) were prepared by Thole and Thorpe's[2] and Deshpande and Thorpe's[3] methods; (c) and (d) by Thole and Thorpe's[2] and Norris and Thorpe's[5] methods. These acids were then converted into their anhydrides and then into mono (acid) esters. The half esters were then treated with Thionyl chloride. The chlorides formed were allowed to react with diazomethane at $-20°$ C. in dry ether. The reaction mixture in each case was kept overnight, during which time the maximum temperature was not allowed to rise above 18° C. The residue obtained from the above was treated (in alcoholic ammonia) with a 10 per cent. solution of silver nitrate and the reaction mixture was then heated to 70° C., filtered while hot. The filtrate on dilution deposited the amide of the required acid which was hydrolysed under reflux with 10 per cent. caustic potash. The alkaline mixture was cooled and then acidified with 2-N sulphuric acid. The acidified solution was saturated with ammonium sulphate and repeatedly extracted with ether. The ethereal extracts were combined, dried, with sodium sulphate and the solvent removed. A slightly sticky brownish mass was obtained in case of (c). It was washed with chloroform and the white solid left after chloroform treatment, was washed with petroleum ether and crystallised from benzene. On examination, it was found to be the desired product, cyclohexane-1-acetic-1-propionic acid, M.P. 169° C. In case of (d) the residue, which was semisolid and sticky, was washed with chloroform and on crystallisation from ether gave a white crystalline substance, M.P. 173°C. This was found to be cyclopentane-1-acetic-1-propionic acid. In case of (a), the combined ethereal extract yielded, on drying, a lactone which was identified as $\beta\beta$ dimethyl-valerolactone, M.P. 29°-30° C. and B.P. 234°-235° C. It was then converted into the required acid by Gustave Blank's method.[6] The acid melted at 87° C. In case of (b) the ethereal extract yielded on drying, a liquid residue, yellow in colour. The residue was distilled under reduced pressure, and a light yellowish oil was obtained from it at 138° C./42 mm. When this oil was removed from the pump and the liquid acquired room temperature and pressure, white needles separated from it. The crystalline substance was separated from oily mother liquor and recrystallised from ether and examined. It was found to be the required $\beta\beta$ diethyl adipic acid and melted at 133°-134° C. The liquid which remained after the removal of the acid was found to be lactone, B.P. 136°-138° C./20-22 mm.

Chemical Laboratories, Allahabad University, February 4, 1948.

L. D. TEWARI.
J. D. TEWARI.

1. Arndt and Eistert, *Ber.*, 1935, **68**, 193. 2. Thole and Thorpe, *J. C. S.* 1911, p. 422. 3. Deshpande and Thorpe, *Ibid.*, **1922**, p. 1430. 4. Thole and Thorpe, *Ibid.*, 1911, p. 440. 5. Norris and Thorpe. *Ibid.*. 1921, p. 1199. 6. Gustave Blank, *Compt. rend.*, 1904, **139**, 800.

## OIL FROM THE SEEDS OF *ZIZYPHUS XYLOPYRA* (WILLD.)

An amber coloured oil whose constants are given below, was extracted out with petroleum-ether in 10 per cent. yield from the seeds of *Z. xylopyra* (N.O. Rhamnaceæ) obtained from Katyani, six miles south of Kolhapur.

Sp. gr. at 26°, 0·9121; $n_D 26°\cdot5$, 1·4725; Iodine value (Wijis), 84·36; Acid value, 10·7; Acetyl value 16·6; Sap. value, 192·8; R-M value, 1·01 and Polenske No., 0·20.

The unsaponifiable matter (0·8 per cent.) consisted of a sterol, m.p. 208° C. (acetate m.p. 62° C.). The insoluble mixed fatty acids (yield 96 per cent.; Iodine value 87·06) obtained by saponification with alcoholic potash and removal of unsaponifiable matter, were fractionated by the lead salt method in the usual manner into saturated acids (28·1 per cent.) consisting entirely of myristic acid (m.p. 53·8° after crystallisation from 80 per cent. acetone; mol. wt. 226) and unsaturated acids (71·9 per cent.; Iodine value 121·7; mean mol. wt. 281·7). The latter gave on bromination in acetic acid solution at 15° C., an oily mixture separated by treatment with ether and petrol into linoleic acid tetrabromide, m.p. 113° C., (Br. 53·5 per cent., corresponding to 34·22 per cent. of linoleic acid) and oleic acid dibromide (Br, 34·6 per cent., corresponding to 65·78 per cent. of oleic acid). Apart from myristic no other acid could be isolated from the saturated acid fraction even by intensive fractional crystallisation from 80 per cent. acetone.

My thanks are due to Prof. J. G. Chohan, Head of the Biology Department, Anand College, for identifying the seeds and to Mr. G. N. Pandit for his co-operation during the preliminary stages of work.

Chemistry Department, Rajaram College, Kolhapur, *March* 11, 1948.

J. W. AIRAN.

## "ANILINE POINT" OF FATTY OILS

Of late there is considerable adulteration of groundnut and cocoanut oils with the so-called technical white oils. There is no ready method of detecting the white oil in the fatty oil and its content is commonly determined either by per cent. unsapofiable matter or by sap value and/or I.V. In an attempt to find out a method which will be short and at the same time simple and fairly reliable, it was observed that 'Aniline Point' is used in the differentiation of paraffin, naphthene and aromatic hydrocarbons. It is defined as 'the temperature of separation into two layers of the equal mixture (of aniline and the sample) when it is gradually cooled down from a temperature at which it is homogeneous.'[1] Thus it is analogous with the critical solution temperatures of fatty oils as represented by the Valenta and Crismer values.

Using distilled aniline and genuine samples of the edible fatty oils and white oils, the following aniline points were obtained:—

| Oil | | Aniline Point—° C. |
|---|---|---|
| Groundnut oil | .. | 16·7 |
| Coconut oil | .. | 3·2 |
| Sesame oil | .. | 8·1 |
| White oil I | .. | 97·5 |
| ,, II | .. | 92·5 |
| ,, III | .. | 93·8 |
| ,, IV | .. | 107·0 |
| ,, V | .. | 108·8 |

There is thus a large difference between the Aniline Points of the three edible oils on the one hand and of the white oils on the other. It should, therefore, be possible to estimate the mineral oil content down to one to two per cent. The following table gives experimentally determined 'Aniline Points' (uncorrected) for mixtures of groundnut oil and white oil I.

| % White oil | Aniline Point—° C. |
|---|---|
| 0 | 17·0 |
| 1·1 | 18·0 |
| 2·0 | 19·0 |
| 3·0 | 20·0 |
| 10·9 | 27·1 |
| 19·7 | 35·2 |
| 30·0 | 45·0 |
| 40·0 | 52·8 |
| 100·0 | 97·0 |

These points are to be taken more as indicating their change with composition rather than showing any exact relationship with it. A closer investigation of the various factors involved and of the use of Aniline Point in the field of fatty oils is in progress.

Dept. of Chemical Technology,
University of Bombay, J. G. Kane.
*April* 9, 1948.

1. Tizard, H. T., and Marshall, A. G., *J. Soc. Chem. Ind.*, 1927, **40**, 20T.

## AN EASY METHOD OF OBTAINING EPIDERMAL PEELS OF GRASS LEAVES

The grass leaves, on account of their anatomy, offer considerable difficulty in removing sufficiently large and satisfactory peels of the epidermis. The usual method of raising the epidermis with a sharp razor or scalpel and peeling off with a pair of forceps fails very often with the grass leaves. One usually gets a tear with the vascular bundles attached. Large peels, especially, with the stomatal tissues are necessary when comparisons of different varieties are undertaken. Prat[1] obtained excellent peels by working away with sharp scalpels and removing the overlying epidermal, chlorophyllous and vascular tissues. When the upper epidermis is required the teasing is to be begun from the lower layer, and *vice versa* for the lower epidermis. This method works very well with leaves of the dicotyledons, especially those with fewer vascular tissues, *e.g.*, groundnut, field beans or lablab and such plants. This technique would be too slow for treatment of materials like paddy in which we had to obtain preparations of a number of varieties, preparations of various positions of the same leaf, those of the leaves of various ages of the same plant, etc., for computing the number of silicated cells amongst the different bands of epidermal cells as rice cells, dumbel-cells, long epidermal and short epidermal cells, bulliform tissue, stomatal tissue and so forth, the area of the silicated cells in the different kinds of tissues comprising the epidermis, etc., in the evaluation of the role of silica in the resistance to blast disease.

We tried some of the maceration methods to obtain the peels quicker. Bits of paddy leaf treated with the common macerater, concentrated nitric acid with potassium chlorate, gave some peels. The disadvantage in this method is that the middle lamella becomes dissolved and the individual cells are separated with the least pressure. The macerater used in the diatom preparations was next tried. In this the leaf is boiled in a 1 : 4 or 1 : 5 concentrated sulphuric acid to which a few crystals of potassium dichromate is added in a test-tube. The contents of the test-tube are then emptied into a dish of water. After a brief washing, to remove the excess acid, the leaf bits are teased out. The exact time required for completion of the reaction should be judged by trial. Over-boiling spoils the preparations and must be avoided. On teasing out, excellent large peels are easily separated. The middle lamella being intact, entire tissues will separate out. The upper and the lower epidermis can be distinguished by the presence of the bulliform cells. Peels taken this way are not damaged in any way and hence are best suited for the study of the epidermal structures. When such peels are stained with Grob's[2] stain (Phenol and Safranin) the silicated cells stand out bright and shining and highly refractive. The non-silicated cells take on the red colour while the silicated cells remain unstained.

Cytogenetics Laboratory, S. Suryanarayana.
Agric. Research Institute, N. Krishnaswamy.
Lawley Road P.O.,
*April* 9, 1948.

1. Prat, H., *Annal. des Sci. Nat. Bot.*, 1932, T. **14**, 118. 2. Grob, A., *Bibliotheca Botanica.*, 1896-97, T. **14**, 36, s. 1.

## A MOSAIC DISEASE OF *DATURA ALBA* NEES

A mosaic disease affecting *Datura alba*, first observed in Poona in August 1939, has since been collected from several places in the Bombay Province.

The symptoms of disease are light green and dark green mosaic accompanied by large blister-like patches of dark green portions of leaf lamina which is much distorted and reduced in

size (Fig. 1). Diseased plants look pale due to their leaves becoming yellowish green at advanced stages of infection. Flowers are also severely malformed and distorted, but the diseased plants are seldom dwarfed.

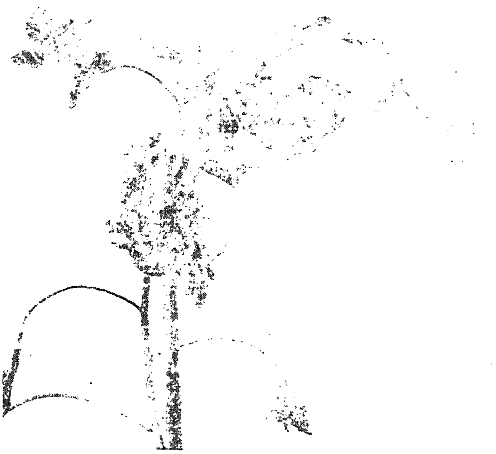


FIG. 1. A diseased *Datura alba* plant showing malformed leaves and flower

In nature, *Datura fastuosa* Linn., is also affected with the virus, but the symptom of disease is only a mild mosaic mottle.

The virus withstands heating for 10 minutes at 60° C., retains infectivity (*a*) at a dilution of 1 in 10,000, and (*b*) after storage for 13 days at laboratory temperature (80° F). It withstands treatment with 95 per cent. ethyl alcohol for 30 hours at 45° F.

The virus is readily transmitted by sap inoculation and by grafting, but not through seed. It is also transmitted by *Myzus persicæ* Sulz. from diseased *Datura fastuosa* to healthy plants of the same species an dalso to *Datura alba* under controlled conditions. In some cases only this aphis transmitted the disease from *D. alba* to *D. alba*.

In addition to *Datura alba* and *D. fastuosa*, the virus also infects tobacco, petunia and potato, and produces local necrotic lesions in *Datura stramonium* and *Nicotiana glutinosa*, but is not infectious to *Phaseolus vulgaris*, *Vigna sinensis* and *Solanum melongena*.

Smith (1937)[1] has described a virus disease affecting *Datura stramonium*, and has designated it as *Datura* virus 1; and Thomas and Krishnaswami (1939)[2] have designated the "little-leaf" virus of brinjal as *Datura* virus 2. The virus affecting *Datura alba*, described in this note, has no affinity whatsoever with *Datura* virus 2; and also shows a marked difference from *Datura* virus 1 in respect of the physical properties, its inability to cause disease in *Phaseolus vulgaris* and *Vigna sinensis*, and the production of only local infection in *Datura stramonium*. Accordingly, it is considered that the disease of *Datura alba* is caused by a new virus not described previously. It is suggested that the virus be known as "*distortion mosaic*" of *Datura alba*, and *Datura* virus 3 according to the classification by Smith.[1]

This work is being done under a scheme financed by the Indian Council of Agricultural Research.

S. P. CAPOOR.
P. M. VARMA.

College of Agriculture,
Poona,
*November* 27, 1947.

1. Smith, K. M., "Text-Book of Plant Virus Diseases," 1937, 332. 2. Thomas, K. M., and Krishnaswami, C. S., *Proc. Ind. Acad. Sci.*, 1939, **10**, 201.

## YELLOW MOSAIC OF *PHASEOLUS LUNATUS* L.

IN December 1939, a large number of double bean (*Phaseolus lunatus* L.) plants grown on the Agricultural College Farm, Poona, showed characteristic mosaic pattern on their leaflets. Tests with the disease proved it to be caused by a virus. This disease has also been collected from several localities in the province.

On inoculation the disease takes 20 days to a month to appear in double bean seedlings in the insect-proof glasshouse at Poona. The first symptoms of disease are the appearance of faintly discoloured patches scattered over the laminæ of leaflets. These patches gradually become bright yellow as the leaf grows to maturity (Fig. 1). Occasionally the entire leaflet becomes chlorotic.

FIG. 1. A leaflet of diseased double bean plant showing bright yellow chlorotic patches

The affected plants are not dwarfed, but continue to grow and bear normally. However,

as the season progresses the production of pods is greatly reduced, probably due to the severity of the disease in the later stages of crop growth.

The virus is readily transmitted by bud-grafting, but is neither sap-transmissible nor carried in seed of double bean. Out of 47 seeds from diseased double bean plants planted in pots inside the insect-proof glasshouse, 45 seedlings were produced, but none of these showed the disease for three months, the period for which they were kept under observation. In transmission tests with insects, the virus was readily transmitted by the white-fly, *Bemisia tabaci* Genn. (*B. gossypiperda* M. & L.), but not by *Empoasca devastans* Dist., *Empoasca* sp., *Aphis laburni* or thrips. The results of the transmission tests are given in Table I.

TABLE I

*Transmission of double bean yellow mosaic virus by grafting and by insects*

| Transmission by | | Plants inoculated | Plants diseased |
|---|---|---|---|
| Bud-grafting | .. | 20 | 14 |
| *Bemisia tabaci* | .. | 30 | 30 |
| *Empoasca devastans* | .. | 15 | 0 |
| *Empoasca* sp. | .. | 11 | 0 |
| *Aphis laburni* | .. | 19 | 0 |
| Thrips | . | 11 | 0 |

In addition to double beans, the virus also infects *Phaseolus limensis*, *P. vulgaris*, *P. aureus*, *Dolichos biflorus* and *Canavalia ensiformis*, but does not go to *P. aconitifolius* and *Dolichos lablab*. Amongst several varieties of *P. vulgaris* tested for infection with the virus, varieties Asgrow Stringless Greenpod and Davis White Wax were found to be resistant to infection, while variety Red Kidney was highly susceptible.

Uppal[1] reported the occurrence of a mosaic disease of *Dolichos biflorus* in this province. This disease has since been shown to be caused by the same virus which affects the double bean plants. McClintock[2] was the first to report the occurrence of a mosaic disease of lima beans, which was shown to be transmitted by sap inoculation and also by two species of aphids by Harter,[3,4] who further concluded that the disease was similar to the mosaic of cucumber and celery.[4] Although in symptomatology the yellow mosaic of double beans resembles the lima bean mosaic[4] and also Bean virus 2 of Pierce,[5] it differs entirely from both of them, as it is neither sap-transmissible nor transmitted in nature by an aphid. Accordingly, the disease in double beans is considered to be caused by a new virus which it is proposed to designate as *'double bean yellow mosaic'* virus.

Grateful acknowledgements are due to Dr. B. N. Uppal for much help and criticisms during the progress of the work. This investigation is being carried out under a scheme financed by the Indian Council of Agricultural Research.

S. P. CAPOOR.
P. M. VARMA.

Dept. of Plant Pathology.
College of Agriculture,
Poona 5,
*April* 30, 1948.

1. Uppal, B. N., *Internat. Bul. Plant Protect.*, 1930. **5**, 163. 2. McClintock, J. A. *Phytopath.*, 1917, **7**, 61, 3. Harter, L. L., *Ibid*, 1936, **26** 94. 4. Harter, L. L., *Jour. Agric. Res.*, 1938, **56**, 895. 5. Pierce, W. H., *Phytopath.*, 1934, **24**, 87.

## POLYPLOIDY IN *PENNISETUM PURPUREUM* SCHUMACH—THE DRY NAPIER

IN the course of the study of the cytogenetics of the $F_1$, of *pennisetum typhoides* × *P. purpureum* (thick-Napier or Elephant grass) and its parents, the root tips of several clumps of the Napier grass were examined. Amongst these were included some of the clumps from the dry-Napier or the thin-Napier grass. The elephant grass usually grows to a height of 18 to 20 ft., with thick sugarcane-like stems and broad leaves. The thin-Napier, on the other hand, grows to about 8 to 10 ft. with thin stems and narrow leaves. The elephant grass root-tips gave consistently a somatic number of 28 long chromosomes (Fig. 1). In 1940 it was observed that a few of the root-

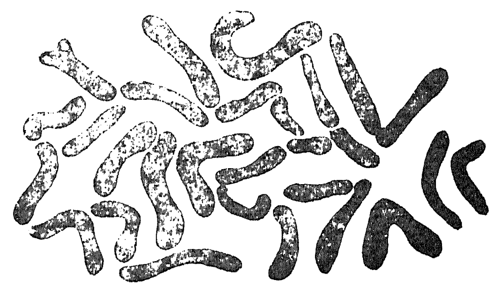


FIG. 1. Elephant grass. × 4960

tips in dry-Napier gave a greater number of small chromosomes than in the elephant grass. An examination of the root-tips of the dry-Napier now, gave again a tetraploid number of $2n = 56$ (Fig. 2). The chromosomes are nearly half as long as in the elephant grass. Only two root-tips were examined. These were collected from tillers from a clump. The tillers were brought to the laboratory and induced to root in water. No nutrient solutions were used but only tap water (within 48 hours quite a large number of roots develop easily and it has been found a convenient method of getting straight, thick roots, especially in grasses). After collection of the roots, the tillers were rejected since it was thought that the number would be the normal diploid. These two roots were, however, found to be completely tetraploid.

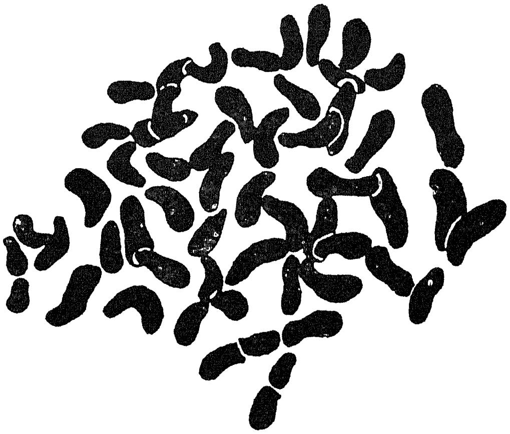


FIG. 2. Thin Napier grass. × 4960

Comparative measurements were done on twenty-five nuclei and cells of both the 4x dry-Napier and the 2x elephant grass root-tips. Only the diameter was taken on the nuclei while the length and breadth of the cells were recorded. The spherical volume was calculated for the nuclei while the area alone was compared for the cells. Gentcheff and Gustafsson[1] have also used a similar method for finding possible correlations between cell size and chromosome number. The cells were chosen from representative areas in the root meristem in both plants. The average nuclear volume in the 4x plants was found to be 577·48 cub.μ., while in the 2x it was 494·1 cub.μ. The mean area of cells in the 4x plant was 650·48 square units and in those of 2x plant 519·39 square units (one unit of the micrometer = 0·69 μ). Thus it is seen that the nuclei as well as the cells are larger in the tetraploid than in the diploid plant. Smears of the root-tips from other clumps of the dry-Napier again gave a 4x number. It is possible, therefore, that the dry-Napier may be a fully tetraploid plant. The clumps which gave the tetraploid roots are kept under observation for study of the meiosis which would then show whether the observed phenomenon is confined only to the roots or whether the entire plant is a tetraploid.

Cytogenetics Laboratory, Agric. Research Institute, Lawley Road P.O., Coimbatore,
*March* 16, 1948.

N. KRISNASWAMY.
V. S. RAMAN.

1. Gentcheff, G., and Gustafsson, A., *Hereditas*, 1939, **25**, 349.

## THE LARVAL PARASITE — *PLEUROTROPIS FOVEOLATUS*, C., OF THE POTATO BEETLE, — *EPILACHNA-28-PUNCTATA*

*Pleurotropis foveolatus*, C. (Chalcidoidea, Hymenoptera) is a common and natural, endophagous parasite, attacking the larva as well as pupa of Epilachna-28-punctata, a serious field pest of potato.

*Adult Parasite* is small, dark and shining with a wing expanse of 3 mm. to 4 mm.; the antenna is black and 7 to 9 jointed; the abdomen is ovate and more acutely pointed in the female than in the male; the legs are black with the distal joints (Tibia and Tarsus) brown in colour; the male is usually smaller than the female.

*Symptom of Parasitisation.*—On parasitisation the host larvæ and the pupæ change their colour from the normal yellow to a blackish-brown or black; the hosts become brittle after a few days. Wherever the parasite is active, such blackish-brown or black host larvæ and pupæ amidst the yellow and healthy ones can be easily observed.

*Incidence in the Field.*—The incidence of parasites was studied from material collected round about Bangalore at random (Table I).

TABLE I

| Lot number | Period of observation | Percentage of parasitisation |
|---|---|---|
| 1 | 25-2-47 | 30 |
| 2 | 5-3-47 | 33 |
| 3 | 14-3-47 | 28 |
| 4 | 19-3-47 | 42 |
| 5 | 25-3-47 | 77 |
| 6 | 26-3-47 | 72 |
| 7 | 1-7-47 | 70 |
| 8 | 8-7-47 | 68 |
| 9 | 17-7-47 | 62 |
| 10 | 23-7-47 | 61 |
| 11 | 24-7-47 | 62 |
| 12 | 26-7-47 | 77 |

results show the maximum percentage of parasitisation reached can be as high as 77. On an average, more than 40 per cent. of the host larvæ and pupæ is attacked and killed.

*Age of the Host Suitable for Parasitisation.* Larvæ, in all stages of development, are stung by the parasite. But the first instar larvæ are not oviposited upon; nevertheless they also turn brown when stung, as individuals of the higher instars do, about 48 hours after the attack. Fully formed pupæ are not usually preferred by the parasite. The second and subsequent larval instars and early stage pupæ are thus found to be suitable for successful parasitisation and normal development of the parasite.

*Period of Development of the Parasite in the Laboratory.*—Laboratory-bred healthy and normal host larvæ were used singly for the developmental studies.

Period of observation: March and April 1947.
Period of development: 11 days.

After full development all the parasites from one and the same host generally emerge out on the same day; rare instances of emergence on different days have also been recorded. Usually females are found in larger numbers than the males (16 : 9) in any one lot of emerged parasites. Very rare instances of males (2 : 1) preponderating over females do occur.

TABLE II

| Culture number | No of parasites emerged | | |
|---|---|---|---|
| | Male | Female | Total |
| 1 | 4 | 13 | 17 |
| 2 | 6 | 15 | 21 |
| 3 | 3 | 13 | 16 |
| 4 | 2 | 15 | 17 |
| 5 | 14 | 7 | 21 |
| 6 | 5 | 7 | 12 |
| 7 | 6 | 15 | 21 |
| 8 | 7 | 12 | 19 |
| 9 | 6 | 7 | 13 |
| 10 | 3 | 4 | 7 |
| 11 | 6 | 10 | 16 |
| 12 | 8 | 14 | 22 |
| 13 | 6 | 8 | 14 |
| 14 | 3 | 5 | 8 |
| 15 | 6 | 6 | 12 |
| 16 | 2 | 7 | 9 |
| 17 | 9 | 12 | 21 |
| 18 | 8 | 11 | 19 |
| 19 | 6 | 16 | 22 |
| 20 | 6 | 8 | 14 |
| 21 | 4 | 12 | 16 |
| 22 | 8 | 10 | 18 |

*Number of Parasites per Host and per Pair of Parasites.*—The number of parasites that emerged in the laboratory out of a single host, subjected to attack by a single fertilised female is:—Average 16; Maximum 22: and Minimum 7.

A number of parasitised larvæ collected in the field were also dissected out and the parasite grubs and pupæ found within were counted as follows:—

| Serial No. | No. of parasitised grubs and pupæ |
|---|---|
| 1 | 12 |
| 2 | 8 |
| 3 | 14 |
| 4 | 23 |
| 5 | 23 |
| 6 | 42 |
| 7 | 38 |
| 8 | 18 |
| 9 | 22 |
| 10 | 26 |
| 11 | 14 |
| 12 | 33 |
| 13 | 18 |
| 14 | 16 |
| 15 | 23 |
| 16 | 15 |
| 17 | 24 |
| Average .. | 22·5 |

A maximum number of 42 parasite grubs and pupæ have thus been counted out of a single host larva, prior to normal emergence.

*Stinging and Egg-Laying.*—The adult female, after finding the host, perches on its back and stings it, which immediately reacts by a sudden quick movement. The parasite leaves the host after its first sting and administers another as soon as the host larva comes to normal. Though the host larva wriggles and gets overpowered after the second sting, the parasite usually stings the host larva for a 3rd time which is prolonged for over 3 to 4 minutes; eggs are laid during this period. If the host is not suited for the development of its progeny, eggs are not laid by the parasite in them.

The eggs are thrust into the host body through the soft intersegmental regions, usually on the dorsal surface; they are laid in groups just below the larval skin. The parent parasite lays eggs at intervals of 15 to 20 minutes and about three thrusts apart from the first two stings are observed.

*Life-Cycle.*—The egg is white, small and oval; the grub hatches out in about 48 hours after the egg is laid and commences to feed into the central region of the host body; in the early stages the parasite is yellowish-white in colour turning whitish by the time it is fully grown; the larval period extends over 6-7 days after which pupation takes place; the grub pupates in the hollow cavity of the host body caused by its feeding on the internal contents; the pupa is naked and the pupal period extends over 36 to 48 hours: the adult parasites emerge through usually one and rarely two pin-holes on the dorsal side of the embrittled skin of the host.

The high percentage of parasitisation of the Epilachna beetle by this parasite gives an idea of how much more virulent the beetle-pest could have been than at present, without the natural check effected by this parasite. This high incidence of the parasite in the field and the ease with which it can be bred in large numbers in the laboratory on the larvæ and pupæ of *Epilachna-28-punctata* (its natural host), which, in turn, can also be bred in sufficient numbers on its alternate solanaceous and cucurbitaceous host plants—such as brinjal, tomato, gourds, cucumbers—besides potato, suggest possibilities of biological control of the potato Epilachna beetle-pest.

I am grateful to Mr. B. Krishnamurti, B.Sc., F.R.E.S., Government Entomologist, for his kind suggestions and general guidance.

Entomological Laboratory,
Agric. Research Institute,
Bangalore, M. APPANNA.

1. Ashmead, W. H., *Memoirs of the Carnegie Museum, Chalcidoidea*, **1**, 4. 2. Krishnamurti, B., 'The Potato Epilachna Beetle', *Department of Agriculture, Entomolgy Series, Bull.* 9. 3. Lal, K. B., and Gupta, K. M., *Curr. Sci.*, 1947, **16**, 158. 4. Ramakrishna Ayyar, T. V., 'The Parasitic Hymenoptera of economic importance, noted from South Indi.' *Bull. Ent. Ser.*, **18**.

## NOTES ON THE LIFE-HISTORY OF THE CHALCID PARASITE, *AZOTUS DELHIENSIS* LAL

*Azotus delhiensis* Lal has been proved to be a primary parasite of the white-fly, *Aleurolobus barodensis,* which according to Karamsingh[1] causes a serious damage to sugarcane fields in the United Provinces, Central Provinces, Bihar, Orissa and others.

*Azotus delhiensis* has been placed by Lal[2] in the family Eulophidæ and sub-family Aphe-

lininæ. It is widely distributed in India specially in the tracts of sugarcane-growing provinces. The genus was originally created by Howard[3] in 1898. He described the species *Azotus marchali*, reared from two specimens *Diaspis ostreaformis* on pea and another from *Aspidotus merii*.

The percentage of parasitisation was studied for two consecutive fortnights.

TABLE I

*Data of Life-History of the Chalcid Parasite* Azotus delhiensis

| Period | Number of pupæ examined | Number of parasitised pupæ | Percentage of parasitisation | Name of the parasite |
|---|---|---|---|---|
| 15-1-1944 to 29-1-1944 | 100 | 24 | 24 | *Azotus delhiensis* Lal |
| 29-1-1944 to 5-2-1944 | 100 | 26 | 26 | do |
| Total | 200 | 50 | 50 | |

Average per cent. parasitisation -- 25

The table shows that the average percentage of parasitisation for *Azotus delhiensis* is about 25 per cent. The parasitisation is greater in December and January and decreases in February and March when it is practically nil. Laboratory studies have shown that the life-cycle at 58° F. is 13 days on the average. The maximum life-cycle is 16 days and the minimum is 11 days.

The parasite appears in the last week of November in large numbers and oviposits in the first week of December. Oviposition takes place for about 30". The first generation adults liberated on a fresh batch of white-fly pupæ under laboratory conditions approximating to those in the field. They were fed on dilute sugar solution, and after copulation were liberated on white-fly pupæ. The first adult emerged in 3 weeks, the second, third and fourth generations successively in about two weeks. Adults of the fourth generation went into hibernation. In the field there was so much of overspreading and overlapping of generations that it was impossible to determine the number of generations undergone. From the observations it seems that the first generation adults took longer to appear.

Experiments on the longevity of the adult *Azotus delhiensis* were carried out both with food and without food. Under laboratory conditions the average length of the life of the adult female is 3¼ days and that of the male is $2^3/_7$ days without food; and with food it is $3^6/_7$ days for the female and $3^5/_7$ days for the male. The maximum longevity for the males is 4 days and for the females is 5 days and minimum for the former is 1 day and for the female is 2 days without food. The maximum longevity with food for the males is 5 days and that for the females is 6 days. It appears that the females are sturdier than the males and can resist the drought much longer. Record of emergence indicates a proportion of 1 male to 4 females. The parasite emerges through a circular hole cut dorsally in the integument of the host near the anterior end.

The parasite displays super-parasitism, and 3 to 5 pupæ of the parasite have been observed in a single pupa of the white-fly. Each emergent adult parasite cuts a separate circular hole in the dorsum of the white-fly pupa.

The egg, larvæ, pupæ and the adults of the above parasite have been studied and will be described at a later date.

I am very much grateful to Dr. M. A. H. Qadri for his helpful suggestions and his kind interest in my work during my stay at Aligarh. I am grateful to Prof. Karamsingh for his kind encouragement, and to Dr. N. G. Shabde, the Principal, for giving me every facility for work in Mahakoshal Mahavidyalaya, Jubbulpore.

Department of Zoology,
Mahakoshal Mahavidyalaya,
Jubbulpore,
*April* 1948.

A. M. LALANE.

1. Karamsingh, *Mem. Dept Agric. (En. Ser.)*, 1931, **1**, 75. 2. Lal, K. B., *Rec. Indian Mus.*, 1938, **40**, 1. 3. Howard, L. C., *Proc. Ent. Soc.*, 1898, **4**, 138.

## ON THE FOOD OF THE 'BEKTI', *LATES CALCARIFER* (BLOCH), IN THE COLD SEASON

MOOKERJEE, Ganguly and Majumdar[1] made a note of the food of 20 specimens of *Lates calcarifer* (Bloch), of about 8·5 inches average length, examined on two days in December 1945. Hardly any additional detailed observation on the food or feeding habits of this brackish-water perch of economic importance is on record. A detailed investigation on the food and feeding habits of this fish which is on hand has brought out the following salient features with reference to the cold season from October 1947 to February 1948.

Systematic analyses of the gut contents of 313 specimens of *L. calcarifer* ranging from 10 inches to 25 inches, collected from the estuarine regions of Bengal and Orissa were carried out. The details of the gut contents and their proportions are given below: --

(1) *Teleosts* (65·34). These consist mainly of Mullets such as *Mugil parsia* and *Mugil* sp.; Siluroids such as *Mystus gulio*, and *Mystus* sp.; Clupeid fishes such as *Engraulis grayi*, *E. parava*, *Stolephorus indicus*, *Dorosoma nasus*, *Dorosoma* sp., and *Coilia* sp; *Lates calcarifer*; *Anabas testudineus*; *Sciænoides microdon* (?); *Eleotris fusca* (?) *Datnioides polata*; *Triacanthus* sp.; *Sillago* sp.; *Leiognathus* sp.; *Gerres* sp.; *Barbus* sp.; *Ophicephalus* sp.; *Cynoglossus* sp.; *Hemirhamphus* sp.; gobies, eels and digested remains. (2) *Decapod crustacea*: (*a*) *Anomura* (23·71 per cent.), consisting of *Palæmon carcinus*, *P. idæ* (?), and *Palæmon* sp.; *Penæus indicus*, *P. carinatus*, *P. semisulcatus* and *Penæus* sp.; *Metapenæus monoceros*, *M. brevicornis*, *M. lysianassa*, *M. dobsoni* (?), and *Metapenæus* sp. (b) *Brachyura* (2·23 per cent.), comprising of Portunid and Grapsid crabs belonging to the genera *Scylla*, *Charybdis*, *Varuna*, and *Sesarma*.

(3) *Minor crustacea*: (*a*) *Isopoda* (0·41%), Isopods (parasitic forms) presumably taken in along with the host. (*b*) *Stomatopoda* (0·4 per cent.), *Squilla* sp. (*c*) *Miscellaneous crustacean remains* (12·15 per cent.) (4) *Molluscan* shells on coconut tree roots (0·01 per cent.). (5) *Insecta* (0·36 per cent.): Insects, young stages of dragon fly and unidentified insect remains. (6) *Vegetable Matter* (0·64 per cent.) These consist of water weeds, bits of grass, cladodes of casuarina and occasionally leaves of land flora. (7) *Digested Matter* (3·9 per cent.): Animal matter digested and mixed with mucus, and (8) *Mud and Sand Grains* (0·85 per cent.): Fine mud mixed with mucus and particles of sand grains.

In four instances the stomach was found to have been pierced by the pectoral spines of the cat fish *Mystus gulio*.

Seasonal observations are continued with a view to making a detailed, comparative study of the food and feeding habits of the fish in the different seasons and stages of growth.

Observations so far carried out show that *Lates calcarifer* feeds actively in the cold season. It is a column feeder, preying mainly on Teleosteans and Decapod crustaceans. Mud and sand in the guts of a few specimens examined were obviously brought in by the mullets which were consumed. The fragments of vegetable matter included in the diet are probably accidental. The 'Bekti' takes a considerable toll of valuable food fishes, like mullets, clupeids, cat fishes and prawns, but the large variety of specimens consumed show that as long as adequate animal food is provided in the environment, 'Bekti' may not destroy the major food fishes exclusively. By providing sufficient quantities of forage fish it should, therefore, be possible to maintain Bekti farms successfully.

I am grateful to Dr. T. J. Job for his kind guidance and helpful criticism.

Central Inland Fisheries
Research Station, Calcutta, P. M. G. MENON.
*March* 15, 1948.

1. Mookerjee, H. K., Ganguly, D. N., and Majumdar, T. C., *Science and Culture*, 1946, **11**, 564.

## THE ROLE OF *MAWA*, AN INDIGENOUS MILK PRODUCT, IN THE NUTRITION AND EPIDEMIOLOGY

MAWA, a crudely manufactured form of condensed milk, is a widely consumed nutritious diet; although the milk is concentrated enough to facilitate transportation, this product still has enough moisture to favour the growth of micro-organisms of which the moulds give visible growth on its surface within about six days of storage at room temperature. It was of considerable practical interest to determine if mawa plays any part in the dissemination of the intestinal pathogenic bacteria.

The chemical composition of several samples (collected on different occasions) revealed that, on an average, mawa contains 10·81 per cent. moisture, 26·71 per cent. proteins, 29·67 per cent. fat, 19·98 per cent. lactose, 3·81 per cent. ash, 1·46 per cent. calcium, 0·66 per cent. phosphorus and trace of iron. The above composition suggests the possibility of mawa serving as an excellent material for the nutrition of both man and micro-organisms.

Bacteriological studies conducted on mawa with *E. typhosa*, *S. schottmuelleri*, *E. coli communis*, *S. dysenteriæ* (Shiga), *S. paradysenteriæ* (Flexner), and *V. choleriæ* have yielded remarkably clear-cut results on repeated experimentations. Mawa was used in the state obtained and in a slightly more moist state and was experimented upon in both its native (non-sterilized) and steam-sterilized states. Incubation was done both at the room (28°-29° C.) and th ebody (37°C.) temperatures. The results obtained clearly show that growth of all the tested species does take place and that the survival period may vary from 14 to 34 days depending upon the species, the moisture and sterility status of mawa and also on the incubation temperature. A detailed report on this work will be published elsewhere.

F. FERNANDES.
J. V. BHAT.
KHORSHED SETHNA

Microbiology Department,
St. Xavier's College,
Bombay,
*May* 1948.

## ACCLIMATISATION OF THE MILLIONS *LEBISTES RETICULATUS* (PETERS) IN MADRAS*

IT is widely believed that the Millions, *Lebistes reticulatus* (Peters), are incapable of withstanding the climatic conditions in the hotter tracts of this country.[1] The species is now considered as not being found in India,[2] but only in Ceylon where it is used for larvicidal purposes.[3] It was, however, found thriving in the tanks of the Rameswaram temple situated in Ramnad district in February 1946 during an investigation of the distribution and local densities of the larvicidal fishes indigenous to the provincial waters. It is possible that it has been introduced from Ceylon, but exact details are not available.

In October 1946 a consignment of about 1,000 fish was taken to Madras with a casualty of only 9 *en route*, and stocked in a concrete garden cistern, in which they bred for the first time in December 1946 and several times thereafter. The stock was then distributed to other waters in the City and to departmental farms and certain private waters in the districts of Tanjore, Cuddappah, Kurnool, Malabar and Salem, where they soon got accimatised and multiplied. Through gradual adaptation the fish has also been acclimatised to brackish waters. The maximum size to which the fish has grown is 1·5 inches in the case of the female and 1 inch in the male. The two sexes occur in equal proportions. The females are dull grey in colour; and the males are iridiscent. Details of sexual dimorphism concerning colour, pattern, body form and size, and of the factors influencing sex recognition in the species have already been recorded by Breder and Coates.[4]

*Lebistes reticulatus* is a surface feeder, and moves about in small groups of 10 to 15. Its food in Madras provincial waters was found to be the following:—

(1) Diatoms and desmids (30 per cent.) *Cosmarium, Closterium, Fragilaria, Melosira, Navicula, Nitzschia, Pinnularia, Suriella,* and *Synedra*). (2) Insect life, including mosquito larvæ (25 per cent.). (3) Crustaceans (20 per cent.) *Copepods, Daphnids* and *Cypris.* (4) Algæ (15 per cent.) (*Anabœna, cladophora, Oscillatoria, Pediastrum* and *Spirogyra.* (5) Rotifers (5 per cent.) Larval forms (3 per cent.). (7) Miscellaneous matter such as sand particles (2 per cent.).

Under artificial conditions it feeds on prawn pulp, oil-cake, mosquito larvæ, cooked rice and egg-yolk.

The breeding habits and development of the species have been detailed by Stoye[5] and Purser.[6] The variations from their observations are indicated below. Maturity is attained when 0·7 inch in size by the male and when 1 inch by the female. The ovarian egg is 1·0 to 1·66 mm. in diameter, whereas the fertilised egg is full of oil-globules and measures 2·0 mm. in diameter. The embryo lies curved over the yolk-sac when 4 mm. in size, showing 8 somites, black eyes and the fin buds. Pigmentation commences when 5 mm. in length, and the mouth cleft appears when 6 mm. in size. The young are released in broods of 5 to 7 at intervals of 3 weeks. At the time of birth the young is 10 mm. long. The yolk-sac is completely absorbed by the third day. Cannibalism is not observed in the Millions; and it lives in harmony with *Gambusia affinis* (B. & G.), *Oryzias melastigma* (McCl.) and *Aplocheilus blochii* (Arnold). While its enemies in its native waters are the fishes, *Crenicichla saxatilis* and *Rivulus harti,* the common frog, *Rana hexadactyla,* is found to feed on it in Madras.

The Millions are successfully used for anti-malarial purpose in other parts of the world. In Madras it is observed to be only of moderate utility, the rate of larval consumption being only 20 to 80 per day. The species may, however, become a useful addition to the indigenous larvicides.

I am thankful to Mr. R. S. Venkatraman for technical assistance.

Inland Fisheries Office,
8, Ormes Road, Kilpauk, P. I. CHACKO.
Madras,
*March* 10, 1948.

* Published with the kind permission of the Director of Industries and Commerce, Madras.

1. O' Donnell, S P., *Rec. Mal. Sur. India*, 1930, **1**, **137**. 2 Hora, S. L., and Mukerji, D. D., *Mal. Bur. Health Bull.*, 1938. **12**, 29. 3. Deraniyagala, P. E. P., *Cey. J Sci.*, 1930, **2**, 191. 4. Breder, C. M., and Coates, C. W., *Zoologica*, 1935, **19**, 187. 5. Stoye, F. H., *Tropical Fishes for the Home, Their Care and Propagation*, 1935, New York. 6. Purser, G. L., *Quart. J. Micro. Sci.*, 1934, **75**, 151.

## THE RADII OF SCALES OF *HILSA ILISHA* (HAMILTON) AS AN INDEX OF GROWTH AND AGE*

SEVERAL explanations on the function and significance of the radii of fish scales have been given by various workers including Raj,[1] on the basis of the mode of disposition of the radii. In *Hilsa ilisha* (Hamilton) occurring in the deltaic area of the Godavari, the radii are arranged transversely. A study of these radii of the scales of the pectoral region of 1,110 specimens has revealed that the number of radii represent the body length of the fish in inches.

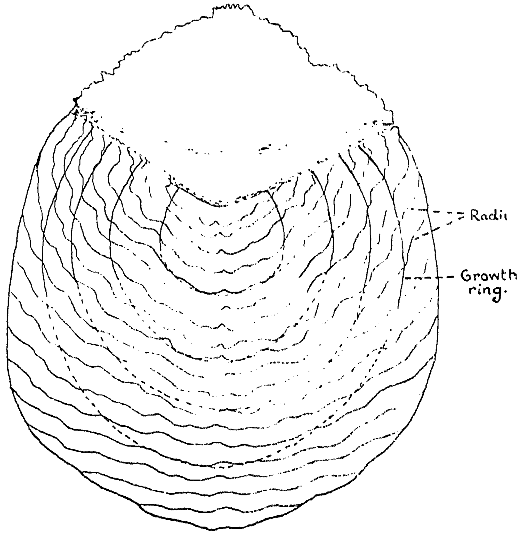



FIG. 1. Diagram of scale of Hilsa, 18·2″ in body length

According to Hora[2] and Raj,[3] the maximum length attained by Hilsa during the first year of its life is 9 inches. And according to Job[4] Hilsa grows at the rate of one inch per month and attains a marketable size and about a foot at the end of the first year. Basing on these observations, the age of the fish can also be roughly determined by counting the number of radii.

The following table indicates the relationship between the body length, number of radii and probable age of *Hilsa ilisha.*

| No. of specimens examined | Length of body in inches | No. of radii on scale | Probable age in months |
|---|---|---|---|
| 87 | 9·8–10·5 | 10 | 10 |
| 114 | 10·7–11·4 | 11 | 11 |
| 112 | 11·5–12·4 | 12 | 12 |
| 121 | 12·5–13·4 | 13 | 13 |
| 127 | 13·5–14·5 | 14 | 14 |
| 114 | 14·6–15·5 | 15 | 15 |
| 98 | 15·6–16·4 | 16 | 16 |
| 117 | 16·5–17·5 | 17 | 17 |
| 79 | 17·6–18·4 | 18 | 18 |
| 88 | 18·4–19·4 | 19 | 19 |
| 39 | 19·5–20·4 | 20 | 20 |
| 14 | 20·5–20·8 | 21 | 21 |

It, however, remains to be ascertained if the fish continues to grow in length and to add to the number of the radii until its natural death. The largest Hilsa so far recorded by the authors is a female spawner, 20·8 inches in body length. It is likely that the fish does not escape the fisherman who comb the river

system with destructive gears; and to this extent further investigation is a stalemate.

Inland Fisheries Office,
8, Ormes Road,
Kilpauk, Madras,
*April* 1948.

P. I. CHACKO.
A. R. K. ZOBAIRI.
B. KRISHNAMURTHI.

* Communicated with the kind permission of the Director of Industries and Commerce, Madras.

1. Raj, B. S., *Proc. 33rd Indian Sci. Cong.*, 1946, **4**, 105. 2. Hora, S. L., *Rec. Indian Mus.*, 1938, **40**, 147. 3. Raj, B. S., *Pro. 4th Indian Sci. Cong.*, 1917, *Absts.* 4. Job, T. J., *Sci. and Cul.*, 1942, **7**, 427.

## MICROFLORA IN BUTTER

THE importance of micro-organisms, especially moulds of the Penicillium and Odium groups, in fat hydrolysis and development of high acidity in butter leading to the production of a high acid ghee is well known.[1,2] In the course of the studies on the microbiological deterioration of market butter, the authors have observed significant differences between *desi* and creamery butters in regard to the numbers as well as species of microflora present in them. The *desi* butter samples were all reported to be prepared from boiled, soured milk and one to two weeks old, while the creamery butter samples were made from pasteurised cream and 24 to 48 hours old. The average fungal and bacterial counts obtained in different samples of butter are given in Table I. Yeasts and moulds were counted on potato-dextrose agar (Difco). Total and differential counts of bacteria were made on China blue agar and coliforms counted on McConkey's agar. Nile blue sulphate agar was employed for enumerating lipolytic organisms, but the results were not satisfactory.

TABLE I

*Counts of fungi and bacteria in butter (log. averages of 10 samples each)*

| Type of butter | Yeast and mould count per ml. | Bacterial count per ml. | | | |
|---|---|---|---|---|---|
| | | Total | Acid producers | Proteolytes | Coniforms |
| Desi butter | 4,915 | 198,500 | 31,030 | 20,180 | 425 |
| Creamery butter— | | | | | |
| (*a*) Salted | 618 | 1,820,000 | 515,200 | 73,500 | 19,000 |
| (*b*) Unsalted | 274 | 2,071,000 | 846,500 | 72,850 | 48,820 |

The types of bacteria, yeasts and moulds occurring in the above samples of butter were isolated and classified on the basis of their cultural and biochemical characteristics. Of the bacterial types found in *desi* butter samples, more than 40 per cent. were lactobacilli (mostly resembling either *L. acidophilus* or *L. casei* species), 20 per cent. mere micrococci and the rest included coliforms, aerobic spore-formers (either *B. albolactis* or *B. subtilis*) and streptococci. In creamery butter, coliform organisms (*A. ærogenes* I, Intermediate and an unidentified strain occurring predominantly) constituted more than 50 per cent. of the bacterial flora; 30 per cent. were streptococci (ether *Str. lactic aromaticus* or *Str. paracitrovorous* strains); 10 per cent. were micrococci (mostly *M. caseolyticus* types); and the rest included species of Microbacterium, Achromobacter, Pseudomonas (greenish fluorescence), Serratia (red pigment) and aerobic spore-formers.

The difference in the type and number of organisms between the two butters is mainly due to the acid environment of *desi* butter,[3] which inhibits bacterial growth but favours development of the contaminating yeasts and moulds. For the same reason the highly acid-tolerant lactobacilli, derived from the starters or utensils, form the predominating bacterial types but they are not considered to possess any influence on fat. Except for the lactose-fermenting spore-former (*B. albolactis*) the other species of bacteria are ordinary contaminants having little effect on the spoilage of *desi butter*. The present work, therefore, confirms the previous observations[1,2] that fungi play a major role in the deterioration of *desi* butter. The description of the important types of yeasts and moulds found in butter and their characteristics will be dealt with in a separate note.

The authors are grateful to Dr. Noshir N. Dastur and Dr. K. C. Sen, Director of Dairy Research, for their kind interest in the work.

M. A. KRISHNASWAMY.
H. LAXMINARAYANA.

Indian Dairy Res. Institute,
Bangalore,
*April* 5, 1948.

1. Davies, *J. Indian Chem. Soc.* (Ind. News Ed.), 1941, **4**, 1 and 150. 2. Rangappa and Banerjee, *Indian J. Vety. Sci. and Anim. Husb.*, 1946, **16**, 98. 3. Ram Ayyar, *Agric. J. India*, 1928, **23**, 107.

## INSTITUTION OF CHEMISTS, INDIA

WHILE highly appreciating the sentiments expressed by Prof. Findlay, it may be pertinent to mention, in this connection, that the Institution of Chemists (India), which was established as early as 1928, has from its very inception been actively engaged in furthering the interests and fostering the healthy development of the profession of Chemistry in this country. It has at present more than 450 members on its rolls, distributed throughout the Indian Union, and has two Branches in the industrial areas of Bihar (Patna) and the United Provinces (Kanpur). The Institution just now has before it a scheme for launching a drive for the further extension of its activities, and its Council is considering a re-orientation of its membership with this object in view.

It may further be mentioned that the Institution has also two organs, a quarterly Journal of its own and another, the Industrial and News Edition, published under the joint auspices of the Institution of Chemists (India), and the Indian Chemical Society.

Chemical Department,
Medical College,
Calcutta,
*May* 15, 1948.

U. P. BASU.

**Darwin's Finches.** By David Lack. (Cambridge University Press). 1947. Pp. x + 208. Price 21*sh*. net.

We have read this fascinating and brilliant book with great interest. It is a notable contribution to our knowledge of the limited ornithological fauna of a small group of Passerine birds of the Galapagos, based on an extensive and critical observation of living specimens inhabiting the Archipelago and the kindred stuffed species preserved in the large series of collections at the California Academy of Sciences, the American Museum of Natural History, New York, and at other scientific institutions.

About fourteen small islands comprising the Archipelago, comprehensively known as the Galapagos, received the generic name from the giant land tortoises which provided food for the roving pirates and men engaged in whale fishery. The islands lie on the Equator in the Pacific Ocean about 600 miles from the Equador, and are removed from the nearest islands of Cocos and Malpelo by about the same distance. The Equadorean names of the individual islands first associated with the crew of Columbus were later given the modern English appellations by the patriotic buccaneers of the *Bachelor's Delight*. Regarding the formation of Oceanic Islands generally there are two rival theories: according to Darwin and his followers they arose from the sea, being elevated above the sea-level by submarine volcanic disturbances and the existing animals on these islands were later introductions; on the other hand the opposite hypothesis postulates that they formed part of the mainland before they were separated from the parent land mass by the deep incursions of the sea, and the island fauna is thus derived from the continent of which the land and animals constituted a part originally.

The title of the book is to be traced to the fact that the whole treatment of the subject-matter refers to the finches which were collected and described by Darwin in 1835 and later further discussed by him in *The Journal* in 1839 on their interrelationship based on the structure of their beaks, abbreviated tails, shape and size of body, plumage and colour variations. Darwin concluded, judging by the relative original paucity of bird-life in the Galapagos and by the perfect gradation in their structural variations, that "one species had been taken and modified for different ends". This important pronouncement on the biological principle of adaptive modification, which has been widely elaborated and applied to other animals since Darwin's observations were made, has formed the study by Mr. Lack, who, while investigating the successive stages in the differentiation of the structural features of the particular group of finches, has extended the application of Darwin's hypothesis to a wider group of organisms living in the Archipelago.

The book is beautifully illustrated. There are 8 coloured plates and 27 text-figures exemplifying extremes of evolutionary changes in the small island group of Passerine birds. The usefulness and value of the book are further enhanced by a comprehensive provision of statistical tables of measurements, an exhaustive list of references and indexes of plants and animals and subject-matter. Students of biology will find in this excellent book sufficient problems for serious scientific study and the general reader will also find great interest in the description of the life-habits of this most fascinating group of birds, treated in a language at once stimulating and attractive.

The expedition to the Galapagos in which the Royal Society and the Zoological Society of London took a keen and practical interest by granting substantial financial assistance, was undertaken before hostilities broke out in Europe, and its results were published on the conclusion of the World War. The book is divided into two parts: the first part is devoted to a description of the islands and the ecological studies of the bird fauna: the second part deals mainly with a more specialised account of the biological theories and problems relating to the origin of Galapagos fauna, the origin and persistence of species and subspecies and adaptive radiation. The Archipelago harbours thirteen species of finches belonging to three genera, *Geospiza*, *Camarhynchus* and *Certhidea*, while the allied form *Pinaroloxias inornata* occurs in the small island of Cocos which lies beyond the Galapagos belt. The principal interest in the study of this small and self-contained group of bird centres in the fact that it is possible to trace the successive stages in their morphological variations from the most trivial changes to these well-defined divergences which distinguish the species and genera. The main object of the author is an attempt at correlating these striking adaptive gradations to new ways of life and interpreting these phenomena in accordance with the well-known biological hypotheses. The evidence collected and presented in the first part is used in the second for a cautious and clear exposition of more than one chapter in the philosophy of Darwinism.

Apart from the fact that the book has a limited province both in material and problems, it has the rare merit of stimulating the reader to take an intelligent interest in the natural history of birds in his surroundings and the biological factors influencing their life.

C. R. N.

**The Dehydration of Food.** By T. N. Morris. (Chapman & Hall Ltd.), 1947. Pp. 174. Price 15*sh*.

The last war gave a fillip to the study of the processes of dehydration of foodstuffs, as dehydrated foods of proper quality were in great demand in almost all theatres of war. The knowledge of dehydration was indeed in a very rudimentary stage before the last war. But as the war continued, systematic researches were instituted on this subject in different

countries and improvement was fairly rapid in the production of high quality dehydrated products.

In the book under review, Mr. T. N. Morris, who is on the staff of the Low Temperature Research Station, Cambridge, has brought together the information gathered mainly by a group of workers of the Ministry of Food and of the Foood Investigation Board of the Department of Scientific and Industrial Research. Researches were mainly carried out at the Low Temperature Research Station, Cambridge, and the Torry Research Station, Aberdeen. In this work the Dunn Nutritional Laboratory, Cambridge, also provided considerable assistance with regard to the nutritive values of dehydrated foodstuffs. The knowledge derived from these planned researches was applied to large-scale practice with the help of some food-manufacturing firms with good results. The collection of all this information in a very handy and readable volume is of special value as with the cessation of war, most of these investigations have been discontinued and scientific interest on this subject has considerably declined. Yet it is generally realised that in case of another war or some other emergency, dehydrated foodstuffs may again be required, and a book of this nature which brings together in one place the latest scientific and technological information on the subject would be particularly valuable as the basis either for immediate application or for further research and development.

The book deals concisely but clearly with the different aspects of the dehydration problem. The value of dehydration in regard to the reduction in volume and weight, thereby saving transport, has been discussed with reference to a large number of foodstuffs like milk, meat, egg, carrot, potato, green vegetables, fish, etc. The nutritive value of the dehydrated foodstuffs compared with that of the fresh samples has also been referred to. The relative advantages of dehydration, canning and refrigeration, the characteristics of biological materials and the general principles and methods of dehydration are dealt with in three different chapters. There are separate chapters on the following specialised topics :—

(1) Dehydration of vegetables ; (2) dehydration of animal products ; (3) precooked, compounded and compressed dried foods ; (4) the storage of dehydrated foods ; (5) packaging of dehydrated foods ; (6) the examination of dehydrated foods from the physical, chemical, nutritional and organoleptic points of view ; (7) the bacteriological aspects of dehydration ; and (8) the control of insects infesting dehydrated foods.

It will thus be seen that the subject of dehydration has been treated comprehensively, though briefly, in both theoretical and practical aspects. Attention has been drawn to recent work on "freeze-drying" which yields products of a high degree of palatability. But hardly any reference is given to a considerable amount of valuable work which has been carried out in America. The inclusion of such information would have enhanced the value of the book. But the author's object has been mainly to present an account of the work that has been carried out in Great Britain during the war years. Mr. Morris's book is a valuable repository of the knowledge on the subject and would be welcomed by all food-technologists.

B. C. G.

**Science News, 4.** (Editor John Enogat, Penguin Books, England), 1947. Price *1sh.*

This number of *Science News* is, like the previous ones, a collection of scientific essays on problems of current interest.

The volume commences with "Life at High Pressures", by Prof. Haldane. This is a description, of characteristic simplicity, of the war work on physiological and psychological reactions of human beings subjected to high pressures. This work was carried out by Prof. Haldane and his co-workers after the Thetis disaster ; and the results were of great value in effecting improvements in the equipment of divers and of submarine crew. Experiments in chambers with oxygen, nitrogen and mixtures of gases at high pressures have revealed an interesting similarity to life in rafied atmospheres, as in aeroplanes and balloons at great altitudes. The curious feature is that oxygen at high pressure is quite as harmful as at low pressure. But, while nitrogen is inoccuous at low pressure, it proves quite toxic at high pressures owing to its rise in concentration in blood.

Other essays like Jet Locomotive, Science and Crime Detection (which is more fascinating than a crime story), Noises from the Sun, Cosmic Rays, and Control of Flowering explain in non-technical language, the recent findings of science and their applications in every-day life. All the matter is so lucidly presented that the intelligent layman is sure to study the book with great interest.

The *Science News* series is truly an attempt to bridge the rapidly widening gap between scientific advance and political backwardness of the human animal. A clear conception of the power for good and evil of science on the part of the democratic citizen and administrator is the surest means of preventing the misuse of science. Publications like the volume under review will go a long way in achieving this object.

K. S. R.

**German Research in World War II.** By Leslie Simon. (John Wiley & Sons Inc., New York; Chapman & Hall, London.) Pp. 84 + 218. Illustrated by numerous diagrams and photographs. Price $4.00.

Leslie Simon's *German Research in World War II* will appeal mainly to two classes of readers. The young scientist interested in ballistics and aero-dynamical problems will find a good deal of information about the German efforts in these fields. Scientific research, and to some extent, development work must, in the ultimate, remain very much an affair of the individual ; and it is known from experience that too much control or organisation

will quickly lower research output from the brilliant to the mediocre level. Still, organisation and administration there must be—especially when a whole nation is geared to the war effort, and this aspect of research is handled either by a senior scientist or only too often by people without a "research" background. The book is of special interest to senior scientists faced with administrative problems, for Col. Leslie Simon has obviously given much thought not only to the German "set up" but also to the general problem of organising research and development work. The reviewer's advice to busy administrators whose contact with research is incidental is that they should "skip" main part of the book and study with great care the last five pages which contain a summary of conditions which foster research. Apart from these classes of readers there must be quite a number of folk who suffered the unwelcome attentions of some of the German secret weapons and survived. Many of these will no doubt find something of interest in the dispassionate revelations of this volume.

Colonel Leslie Simon's book is largely based on the work of special investigators who followed the advancing armies into Germany, and who endeavoured to collect information and material either of scientific value to the U.S.A. or likely to be useful in fighting Japan. The actual investigatory work was often hampered by the destruction of equipment and records, by the allied attacking troops by the inmates of neighbouring slave-labour camps after release, and sometimes by the Germans themselves.

Further, the German scientific staff had frequently dispersed. These individuals had first to be located and retrieved for questioning. Another difficulty was that the Germans for their own security reasons, did not always disclose the full scope of the problem to individual workers or even the heads of institutions. We are warned by the author against setting too high a value on German achievements since comparative work on the part of the allies must often remain secret.

Surveys are given of the Hermann Goering Air-Force Research establishment near Braunsweig, the Graf Zeppelin Aero-research installation near Stuttgart and the military proving ground at Hillerslehen. In the author's own words, "The research establishments of the German Air Force were the most magnificent, carefully planned and fully equipped that the world has ever seen". The preeminence of the Air-Force research is accounted for partly by the personal influence of Goring and the fact that a competent scientist whose "Nazi" qualifications fell below standard would enjoy a certain measure of protection if employed in an air-force establishment. Army weapon research was, on the other hand, largely stultified or smothered by the powerful armament firms which possessed research and development facilities but which tended to improve existing weapons rather than originate new ones. The general impression is that the German scientists were paid on a scale, not lavish, but sufficient to free them from such financial embarrassments that beset many of the British scientists in the later stages of the war.

Diagrams are given showing the research and development organisations relative to the Air, Sea and Land Forces. These arrangements were apt to be disturbed by strong aggressive personalities, and the army organisation underwent considerable modification when Nazi Government, previously neutral towards research, demanded "miracle" weapons in the later stages of the war. A further comprehensive re-organisation scheme affecting all research establishments was "under way" when Germany collapsed.

In view of the author's experience and qualifications, it is not surprising that as regards the actual experimental work and equipment, he has tended to confine his descriptions to numerous ballistical and aerodynamical problems. These are of specialised interest, and reference will be made only to one or two outstanding features. Wind tunnels operating continuously at supersonic velocities require enormous power. The Germans were able to conduct some successful experiments by utilising the airflow associated with the sudden charging of a huge air reservoir which had previously been gradually evacuated with pumps of moderate power. An interferometer technique was developed for studying air density changes near models undergoing high velocity wind tunnel tests. In their study of blast or shock waves the Germans devel[oped] the condenser microphone technique, and little use was made of piezo-electric crystal pick-ups. The shaping of explosive charges in order to obtain directional explosive effects came in for a good deal of attention, and it was discovered that spin-stabilised projectiles were unsuited for cavity charges. Ordinarily, projectiles are either fin or spin stabilised. The Germans found it possible to stabilise high velocity short-range projectiles by means of a deeply grooved nose-piece. Fortunately for the Allies, problems associated with high altitude precision bombing were apparently neglected by the Germans until a very late stage of the war.

The author believes that the outstanding German armament achievement was the development of an effective rocket to be fired from aircraft. Although the Germans undertook considerable research in connection with the turbo-jet propulsion of aircraft the author is of the opinion that precedence must be given to the Americans in the field.

In view of past reputations it seems strange that a valid criticism should be levelled at German instrument design. Yet, for various reasons there was a tendency to perfect existing types of instruments rather than to develop new instruments for novel techniques.

Col. Simon's book not only deals with German war-time research and development but also gives at length the author's views on the general problems of research. Obviously the author has given much thought to these matters and this volume should be consulted by all those who would organise and control a re-

search establishment without destroying the ideals of an enthusiastic research staff.

FRANK ADCOCK.

**De Revolutionibus.** By Nicolaus Copernicus. Preface and Book 1. Translated by J. F. Dobson and S. Brodetsky. (The Royal Astronomical Society, Burlington House, London, W. 1) Pp. 32. Price 3*sh*. 6*d*.

The birth of modern astronomy dates from the year of publication of the epoch-making book of Nicolaus Copernicus (1473-1543) entitled *De Revolutionibus Orbium Cœlestium* (On the Revolutions of the Spheres of the Universe). For nearly fourteen centuries before Copernicus, the *Almagest* of Ptolemy was the undisputed "scripture of astronomy". The system expounded by Ptolemy regarded the earth as the centre of the Universe around which all the heavenly bodies revolved in circles. To explain the apparent motions of the planets against the background of the fixed stars, Ptolemy devised a system of 'epicycles', each planet moving in a circle while the centre of this circle moved in a bigger circle round the earth. As more and more observational data relating to the motions of the planets accumulated, it became necessary to modify the Ptolemaic system by adding more and more epicycles until the entire picture became very confused and complicated. It was at this stage that Copernicus came forth with his new theory. Copernicus saw that the rotation of the earth from west to east could explain equally well the observed motions of the heavenly bodies as the rotation of all the heavenly bodies in the opposite direction round a fixed earth. Although Ptolemy had rejected such a hypothesis as contrary to commonsense, Copernicus clearly realised its simplicity and emphasised the fact that only relative motion is perceived by the senses. He also recognised that the "Heavens are immeasurable in comparison with the Earth" and, therefore, it was much more probable that the earth, rather than the vast universe, revolved once in 24 hours. He then showed that most of the observed facts of planetary motion could be explained by supposing that all the planets including the Earth revolved round the sun in circular orbits. With certain important modifications at the hands of Kepler, this is still the system which is accepted to-day.

Copernicus foresaw that his theory was bound to meet with violent opposition and refused to publish it for 36 years. At last he yielded to the wishes of his friends and his great book *De Revolutionibus* in which he has set forth his theory at great length was printed in 1543, the year of his death. He did not live to see the printed copy of his book. The book is dedicated to "The Most Holy Lord, Pope Paul III". Copernicus was a mathematician. In the Preface of dedication he has stated that he got his basic ideas from the writings of Greek philosophers belonging to the Pythagorian school and has expressed his conviction that although "idle babblers, ignorant of mathematics" might criticise his work, "gifted and learned mathematicians" are bound to appreciate his theory.

The Royal Astronomical Society has rendered a valuable service in bringing out an English translation of the famous book of Copernicus, thus rendering it accessible to a larger circle of readers. The book should find a place in the library of every scientific institution.

R ANANTHAKRISHNAN.

**An Introduction to Vertebrate Anatomy.** By H. M. Messer. Second Edition. (MacMillan and Co.), 1947. Pp. 475 + xx. Price 24*sh*.

The revised edition of the *Vertebrate Anatomy*, by Messer, is most welcome since the author has amplified considerably the material of the one-semester course which he projected sometime back and also because certain erroneous concepts in comparative morphology have been clarified.

The book consists of thirteen chapters and each chapter concludes with a summary of the main important points. After a brief introductory chapter dealing with definition of terms, etc., the author gives a clear account of the chordate characters in the next. The protochordates are treated in Chapter III taking Balanoglossus, Ciona and Branchiostoma as types. The author has rightly stressed upon the incorrect homology established between the endostyle of Branchiostoma, the subpharyngeal gland of the larval Petromyzon and the thyroid gland of vertebrates likewise; it is also pointed out that the so-called liver of Branchiostoma, in secreting enzymes, behaves more like a pancreas.

Chapter IV deals with the Vertebrate classification and the characteristics of the groups—the Agnatha comes first and is succeeded by a chapter on Osteichthyes. The figures of Bdellostóma, Petromyzon, Clupea and Squalus could be made more useful if drawn better to show as much of the externals as possible and the parts labelled. Similarly, the figures of Amphibians (pp. 58, 59) are rather crude when compared with those of reptiles and mammals in the following pages. The hares and rabbits are treated separately under a different order, Lagomorpha, from the Rodentia including Sciurus, etc.

Early vertebrate development forms the theme of the next chapter; subjects like maturation, structure of sperm, fertilisation, segmentation, gastrula and the formation of germ layers are clearly described. Terms like cœloblastula and discoblastula are used to describe the Branchiostoma and frog blastula on the one hand and chick blastula on the other.

The integumental structures are described in Chapter VI. The so-called enamel of the clasmobranch placoid scale is shown to be a harder kind of dentine and, therefore, the scale is entirely dermal in origin. An epidermal enamel organ though present does not contribute towards the formation of the scale.

Chapter VII deals with skeleton. While the usual number of cervical vertebræ is seven, exceptions like Manatus (6), Bradypus (9), etc., are noted. The fallacy of the ventral rib (fish) and dorsal rib (most other vertebrates) is pointed out to be no more tenable since these may change their position during development. In the tabular statement (p. 104) of

the chief bones of the skull, the pterotic and sphenotic are classed as dermal bones which is not correct. The term 'alisphenoid' is still retained to describe the pleurosphenoid in the teleostomes. In the figure of Amia (p. 187) the pre- and post-frontals, hyomandibula and quadrate are not delimited. In the figure of *Necturus* (p. 187) the term 'paraquadrate' is used to designate a bone which is now accepted to be squamosal in Amphibia. For the salientian paired "ethmoids' the term sphenethmoid and for the so-called fused fronto-parietal, the term 'frontal' is to be preferred.

With regard to the Python skull (p. 189), the demarcations of pre- and post-frontal and post-orbital are not clearly indicated; in the Sphenodon skull (p. 190), similarly the squamosal, quadrate and jugal. In the skull of the bird (Fig. 204) the 'prefrontal' should be read as lacrimal. In the chart on p. 195, giving an idea of the phylogeny of the visceral arches excluding dermal bones in the vertebrate classes, the author tabulates under Osteichthyes, the quadrate and articular; it is not explained why the metapterygoid and antopalatine which are not always dermal bones are omitted; the so-called articular of previous authors is now shown to be as angular. A correct idea of the nature of tails of fiishes is given; the protocercal caudal fin of cyclostome and fish embryos, the heterocercal type of elasmobranch fishes, and the symmetrical diphycercal tail which becomes secondarily so from a heterocercal type is noticed in Crossopterigians and Dipnoi.

The muscles and digestive system are described in Chapters VIII and IX respectively. In the latter chapter, the dental formulæ of some mammals are given and for that of the cow, the incisors and canines are noted as 0/3, 0/0 which should be corrected as 0/4, 0/0.

The respiratory system is described in the next chapter. In the part dealing with the comparative anatomy of the organs, the structure and mechanism of respiration is described in the various classes. In the adult frog, the external nares are described to possess 'valves' closing and opening the orifice; the Fig. 44 (p. 54) shows clearly the premaxillæ as valvular in function, which is correct.

In the chapter on circulatory system, the evolution of the arterial arches is brought out in Figs. 308-310; the usefulness of these figures could be enhanced if the subclavian arteries in crocodile and the mammal are labelled. The arrow heads are missing in Fig. 310*b*.. Since no English text-book on Zoology gives figures of the circulatory system of a turtle, the inclusion of it in the book under review is most welcome.

The excretory and reproductory systems are dealt with in the two succeeding chapters.

In Chapter XIV, the Nervous System is described. Very useful comparative figures of the sagittal sectional views of the vertebrate brain are given. While it is commonly described that there are 8 cranial nerves in Cyclostomes, 10 in an-amniotes and snakes and 12 in amniotes, the anterior sensory nerve called the terminal noticed in all vertebrates (except birds) naturally adds one to the number. The author includes this in the tabular statement on p. 385 and points out that "it is now thought to be associated with the autonomic system" (p. 386).

Sense organs form the theme of Chapter XV, and in the next chapter, the endocrine glands are described. While the function of the cortical portion of the suprarenal is not known, the medulla secretes adrenalin which "produces an increase in the amount of sugar available as an emergency fuel". Secretin, produced by the duodenum governs the secretory activities of liver and pancreas.

The last chapter (XVII) is on the 'Origin and Evolution of Vertebrates'. Discussing this problem, the author points out that "It seems highly probable, therefore, that the chordate highway branched off from the one leading to the higher chordates at an early date in the history of animal life, perhaps as far back as the cœlenterates. The exact ancestors still remain obscure.

There is an useful bibliography, a glossary and an index.

Systematists may not agree with the use of the names, Amphioxus, Triton, Nototrema, Galæopithecus, Echidna and Lepus; and we hope that the errors pointed out will be set right in the next edition.

The get-up of the book is excellent and we have no hesitation in recommending the book to every student of comparative Anatomy.

L. S. R.

**Natural Resources and Human Adaptation.** By A. M. Lorenzo, Lucknow University. (Universal Publishers Ltd., The Mall, Lucknow), 1947. Pp. 100. Price Rs. 3-12.

Whether or not one feels able to agree with the judgment of Dr. Lorenzo that notwithstanding centuries of "give-and-take" and cultural contact, "the East remains essentially spiritual, the West largely material . . ." there can be no doubt that the volume under notice in which he has endeavoured to demonstrate that progress and advancement achieved by different nations of the world are directly dependent on their efficient and successful adaptation to and development of the Natural Resources that act as a challenging stimuli eliciting characteristic reactions, will be welcomed by all students of Geography, Sociology and allied disciplines as calculated to make a real and substantial contribution to the solution of the permanent and persistent problem, difficult and defiant, of definitely observed differences and disparities in the forms and patterns of adjustment and adaptation revealed by the nations of the world to the environment of Natural Resources. There is perhaps a borderland, a No-man's land, encircling with appropriate points of contact, "geography, economics and sociology", and "in this book", the author "has tried to explore this border region to study the physical resources on which the structure of economic life and social institutions rests". Devoting the opening chapter to an analysis of the "Concept of Natural Resources", the author explains that all natural things such as air, water, sunshine, etc., which

lie within reach of man and can be turned to his benefit, belong to the category of "Natural Resources". In the course of the second chapter, a scientific and systematic classification of "Resource-Patterns" is attempted. Examining the foundations of the "Natural Resource potential", the author emphasizes in the third chapter factors, "locational, physiographical, climatic, biological and social". How are these resource-areas constituted? The fourth chapter contains a brief account of the nature and characteristics of the Regions of Bounty, of Increment, of Effort, of Arrested Development, and of Lasting Difficulty. How are these resources to be critically judged and assessed? The conditions of such assessment are elaborated in the fifth. The author has detected something like a hierarchy in the manipulation and control of these resources, marked by three stages, the *etiological, ecological*, and *epharmological* to an account of which the sixth chapter is assigned. That economic relationship is governed by the movement of resource-surpluses of one area to another, deficient in such resources, is emphasized in the seventh. On the basis of resources, how is the Economic Strength to be determined? The author concludes in the eighth chapter that the "vegetable civilizations of to-day are economically poorer than the industrial machine civilizations". Modern political geography is shaped and controlled, the author trenchantly observes, by aggressive capitalistic and industrialized nations who, by hook or crook, are bent on acquiring and possessing such areas as contain the Natural Resources necessary for their economic strength and stability. In the tenth chapter, the author indicates the conclusion that stability of civilization and degree of social progress depend not merely on the availability of resource-potential but on such potential being utilized systematically and successfully to the maximum possible advantage.

In view of the importance of the lines of investigation pursued by Dr. Lorenzo, and in view particularly of the specific problems of industrial research and reconstruction that are confronting modern Free India, I have thought it necessary to give the fore-sketched summary of the main elements of value contained in the volume under notice. For centuries past, India has been known as a country devoted to devement of spiritual and philosophical culture. It is illogical and unscientific to believe that Indian culture neglected or condemned material advancement. It is only excessive and exclusive preoccupation with the latter to the utter and complete exclusion of the former that had been denounced by teachers of religion and builders of philosophical systems. Indian culture came into contact with Western, European and American patterns. Reaction must be inevitable. It is, however, a thousand pities that the reaction has not been to the advantage of India.

Dr. Lorenzo points out that only those people and nations that possess resources of workable and unfailing combination of coal and iron would rise to a position of "world-domination, economically, politically and culturally". It will easily be realized that to coal and iron, *Uranium* should now be added on as the final and most decisive resoure-potential. Where objective scientific research is concerned, there is absolutely no use of ethical, moral, and other types of sentimentalism. The truth must be obvious except to those suffering from deep-rooted patterns of perverted cerebration, that, in Hiroshima and Nagasaki, Japan got the only fitting reply to Pearl-Harbour treachery. If, on the contrary, modern America had failed to develop the resource-potential of *Uranium* into concretised Atomic-bombs, and if again, overcome by some type of morbid and abnormal sentimentalism, America had actually thrown open her gates to the invading Japanese, *without any malice at heart* over Pearl-Harbour, World War II would not have come to an end in the present way, and world-history might have had to be re-written.

Be it in Physics or Chemistry, Biology or Psychology, the one central aim should be to transform as much as the Natural-Resources-Potential available into agencies of economic and political power both for resisting the aggressions of unscrupulous invaders and for constructive enhancement of the hedonic hue and tone of life. You cannot have it both ways. Nor would running with the hare and hunting with the hound be possible or profitable. If one has firm and unshakeable faith in the spiritual disciplines of India and the East, he should embark on quest eternal, leaving economics and politics severely alone. If, however, he has firm faith only in laboratory sciences grounded on laboratory verification and qualitatively and quantitatively determined analysis, he must endeavour to harness scientific conclusions and scientific methodology to the task of immediate improvement of the Natural-Resources-Potential available in this country and of enabling the country and people to preserve the freedom and independence from ambitious aggressors and eager exploiters. If spirituality and politics are allowed to coquette with one another, only deep and poignant frustration can result. Such is the much-needed and valuable truth emphasized by Dr. Lorenzo, though he may not strictly be responsible for the conclusions drawn by me and the language and terminology in which they have now been expressed, which are, of course, my own.

The fall of modern Germany and Japan, notwithstanding their perfect control over the scientific and industrial technique of developing the Natural Resources, must make internationalists rub their eyes. There is, however, no need to lapse into fatalistic, philosophical, or spiritualistic speculations. As Dr. Lorenzo points out in his prefatory note, if the world's goods be distributed equitably between the "haves" and the "have-nots", you can build a Paradise on Earth. Science can just study facts as they are and explain natural phenomena as they unfold themselves in the evolutional process. Science can never explain why Nature should be bountiful in certain zones and why so miserly in others. Indian scientists should, therefore, concentrate all their energies on transformation of India's Natural-Resources-Potential into concrete economic bene-

fits and sources of material comfort and happy and healthy living.

I desire to offer only one more comment in conclusion. Dr. Lorenzo says that he is "presenting an *argumentum ad hominem*". In ordinary, common logical parlance, that is the name of a logical *fallacy*, an error in reasoning, based or grounded on appeal to passions, prejudices, personal predilections, etc., and not on appeal to *reason* (*i.e.*, *Argumentum ad judiciam* used by all Science). As a matter of fact, Dr. Lorenzo's treatmnet of the rather complicated subject-matter of political geography or geographical politics is so clearly reasoned and scientific that no one will ever associate it even in the remotest degree with any logical fallacy. The bibliography at the end of the volume makes it a highly useful research-document on which Dr. Lorenzo may sincerely be felicitated.

R. NAGARAJA SARMA.

**Note on the Results of Diet Surveys in India.** By W. R. Aykroyd. (The Job Press, Cawnpore), 1947. Pp 35. Price Re. 1.

This Special Report No. 16 of the Indian Research Fund Association is a revised and enlarged edition of an earlier Report, No. 3, published in 1939. The need for diet surveys conducted on random groups of population of various economic strata can hardly be overemphasised. While food resources of a country give a rough idea of average food consumption, such averages conceal wide variations in food intake in different areas within the country and in different economic and social groups. On the other hand, actual diet surveys give a truer picture of food consumption, an information which is at once useful both for correcting quantitative and qualitative deficiencies.

In the present publication are included surveys conducted in undivided India, Burma and Ceylon. Out of a total of 153 surveys, 132 relate to India. The surveys cover 4,730 families and about 21,000 individuals. About 75 per cent. of the surveys were made in villages the remainder being carried out in urban and semi-urban localities. A high intake of cereals relative to that of other foods is characteristic of all the groups except a few of higher economic level. The surveys also reveal that, even in normal times, about 30 per cent. of the population does not get enough to eat. Much data of interest to nutrition workers have been obtained as a result of these diet surveys which are neatly summarised in the first few pages. They are, to cite a few: consumption of milk and milk-products tends to be relatively more in the case of wheat-eaters than with rice- or millet-eaters (it should not be understood from this that rice-eaters have an inherent aversion to milk; if they take less milk, it is because of limited supplies only); there is a general all-round improvement in the diet with increase in income, except in the intake of leafy vegetables. The composition of a model balance diet is given as a guide for effecting improvements in diet. Perhaps, progress in this direction is tardy on account of the prevailing food shortage; but this, it is hoped, is only a passing phase.

The Report is very well got-up and should prove immensely useful to those interested in the food problems of India.

S. RANGANATHAN.

**United Nations Bulletin of the World Health Orgaisation.** Vol. I, No. 1, 1947-48.

This Bulletin has articles on six subjects and is a boquet of mixed flavour. The aim, as stated in the editorial, is "*to assist in developing an informed public opinion among all peoples on matters of health*". This bulletin claims to be the heir of *Bulletin of the League of Nations Health Organisation, etc.* For the present, the bulletin will be published in two languages only—French and English. It will gladden the hearts of all Indians to know that the expert committee on Biological Standardization has Lt.-Col. Sir Sahib Singh Sokhey as a member. Routine standardization, and approval of standards for Heparin, Penicillin, vitamin E, Oestrus hormones, etc., antitoxins of perfringens, etc., are listed; replacement of standards to suit new environmental conditions have also been ordered. Vaccines for Pertussis, Cholera. Plague (pestis), Smallpox and Yellow-fever cannot be standardised at present, and exchange of relevant strains of bacteria have been recommended. An effort to standardise human anti-A, anti-B, and Rh nomenclature has been indicated, as also the necessity for standardisation of potent penicillins and streptomycins.

The question of therapy and chemoprophylaxis as regards dosage for suppressive and curative treatment of malaria has been modified, because of wider experience on exposure of non-immune subjects to malaria in hyperendemic areas. Causal prophylaxis in doses well below the toxic level which has a total value against *P. falciparum* and a partial one against *P. vivax* is discussed. Contact insecticides like Gammexene and D.D.T. have perhaps reduced the cost of malarial control. But concerted, continuous, persevering action controlled *Anopheles gambiae* in Brazil and Egypt, even before the days of D.D.T., and one can hope for a greater degree of control by D.D.T. and other potent contact insecticides.

The comparative value of chemotherapeutic drugs, Atebrin, 4 Aminoquinolines SN 6911, SN 7618 (Reschin—SN 7618—is superior to Atebrin and had been patented by the Germans in 1939; it does not discolour the skin), 8 Aminoquinolines, and the biguanides specially of Paludrine. are discussed.

D.D.T. as a *larvacide* is expensive and may be almost useless in rainy season and where the mosquitoes breed in non-human habitation regions (spraying has to be done by aeroplane); as a mosquitocide in house-sprayings it is the most useful drug and the budgetary portions of Health of each nation will have to be considered where the purchase of D.D.T. as a recurring annual cost will figure. The reduction of the cost will depend on (1) bionomics of anophelines, (2) methods of application and (3) organisation measures. The last article of the bulletin, "On Malaria Control Campaign in Greece, in 1946", by Dr. M. J. Vine, may be read with the above.

Points made out by him are that D.D.T. for malaria control cannot be used near apiaries or where Bee-keeping has become an industry—the bees die out; nor where Silk-worm rearing is a cottage industry (as in parts of Mysore State—T. Narasipur, Chamarajnagar Taluks). Silk-worm rearing is impossible if D.D.T. is used (one should bear this in mind before purchasing large quantities of D.D.T. for general use by provincial governments). D.D.T. is of great use to kill mosquitoes which are not androphylic but zoophylic and Dr. M. J. Vine grows enthusiastic over its use on this aspect. In the Mysore State it may be necessary to spray D.D.T. by air plane once a month over swamps, channels and lakes, to act as larvicide if the Greek experience is taken as a criterion.

An important note on the immunity reaction, following vaccination against smallpox and post-vaccinal encephalitis is appended. Allergic, reactions are noted. Marsden's and Craigies' statements are well worth repetition. "Immune reaction is only sensitisation." "Elementary bodies of vaccinia, washed and killed by formalin, elicit an early reaction on individuals previously vaccinated." "Sensitivity and immunity to vaccine virus are not necessarily related except in so far as they have a common origin in a previous vaccination."

During the intensive campaign of vaccination in 1939-40 in the Mysore State, the reviewer had noticed extreme redness and regular allergic reactions starting within a few hours to 24 hours of vaccination and continuing for over seven days. Quite a few cases of staphylococcal infections were noticed. It was suggested that buffalo proteins (buffalo calves are used for preparing anti-smallpox vaccine) were the sensitising agents and staphylococcal infection played a secondary role in the cause of illness after vaccination. But the authorities would not accept this simple explanation and it does cheer one to find the same type of explanation offered by the eminent scientists of the World Health Organisation.

Cases of post-vaccinal encephalitis have never been reported in India. In syphilis, India has escaped, rather narrowly (fewer cases of nervous affection as G.P.I., etc., occur in India, due perhaps to the spirochetal toxin spreading itself on the skin (nerve and skin start from the ectoderm and the poison spreads itself on the skin—is it dermotropism?) than on nerve tissues. In the same way, is it possible that post-vaccinal encephalitis, so much dreaded in countries like Holland, Great Britain, etc., does not occur as the poison spreads itself in the skin only in India. It may also be that the disease is not recognised, but this is hardly possible when we have so many brilliant medical men among us. Post-vaccinal encephalitis is discussed by five authors very learnedly; but so far as can be seen, they have arrived at no definite conclusion.

Rat infestation by fumigation on ships and methods of estimating rat population, the decision for the necessity for fumigation are discussed by Dr. M. T. Morgan.

Relapsing fever epidemics in North Africa is the subject-matter of two papers by Drs. Gaud and Morgan. Fortunately the disease which had appeared in S. India in an epidemic form in 1925 (in Nilgiris), died out rapidly—but the menace cannot be said to have been eradicated for ever. The epidemiological aspect is discussed in an instructive way.

A very long article on Tuberculosis in Greece, by Dr. McDougall, is the penultimate article. This article hurts a sensitive Indian mind. UNRRA has poured men, money and material to Greece purely for political ends. When millions died in Bengal of starvation, UNRRA did not offer any help. "Blood is thicker than water", and "East is East and West is West" are trite sayings, but how true these sayings appear when one sees the amount of help given to a small country like Greece, and when none was given to India when her soldiers fought on all battle-fronts to guard the "Churchillian four Freedoms"!

The article reports on the difficulties met with, and how they were overcome by persistence. How different are conditions here!

The Bulletin is a welcome addition to the literature of Preventive Medicine, and should be perused by people who are interested in this aspect of medicine. Future copies of the Bulletin will be welcome.

C. V. NATARAJAN.

**Physiology of Man in the Desert.** By E. F. Adolph and Associates. (Interscience Publishers, Inc., New York; Interscience Publishers Ltd., London), 1947.

This monograph is an excellent contribution to environmental physiology and embodies the results of careful research carried out by the members of the Rochester Desert Unit, organised under a contract between the U.S.A. Office of Scientific Research and Development and the University of Rochester. The book is written in a simple and lucid style and furnishes very valuable information to any one who wishes to know something about life in a desert, and in particular to those engaged in desert warfare. There is also ample material in this report, particularly in Chapters 6 and 10 to 14, useful to the physiologists, pathologists and physicians.

Based on the statistical data obtained and personal observations made during the period of research, the authors have been able to record the following fundamental facts which are of great importance.

Thermal stress in the desert is 2-3 times that in the tropics, owing to a high radiant heat gain from the direct solar rays and high reflectivity of the sand. Under most desert conditions, humidity plays a negligible role while wind velocity plays a more important part. Clothing is very efficient in shielding a man from a considerable fraction of this radiant gain. Although by removal of clothing a man may feel more comfortable, in any circumstance where water shortage is a possibility, the desert traveller should not remove his outer garments particularly when exposed to direct sun's rays.

The daily sweat output of man in the desert is twice that in the tropics, and is estimated

accurately by subtracting urinary output from fluid consumed. In the desert, 90 per cent. of water lost from the body is spent as sweat, and the loss may range up to 11 litres per day. The rate of sweating is nearly proportional to 2/3 power of body-weight, and so heavy men sweat faster. There is no suppression of sweating even if body is depleted of water to the extent of 10 per cent. of the body-weight. A deficit of 5 to 10 per cent. of the body-weight of water may be set right without ill-effects, but a deficit of 20 per cent. would reach an irreversible state. The predominant physiological need of man in the desert is to replace the loss by drinking sufficient quantity of water, well in time before dehydration is extreme. Inadequate supply of water in a desert is a patent error.

The most obvious ways by which man can economise on his need for water in the desert are (1) cease activity, (2) avoid the sun and (3) remain clothed. A man who lacks plenty of water should refrain from taking foods that contain proteins or salts.

Of all signs which may indicate the approach of dehydration exhaustion, a high pulse rate and a high rectal temperature are the most dependable. They are good indicators of the circulatory strain caused by reduction in the circulating volume of blood and the increasing blood viscosity. The lower the pulse rate, the greater is the fitness to perform work in hot atmosphere.

Dehydration exhaustion is closely allied to heat exhaustion but heat stroke which includes signs of disorganised thermo-regulatory ability, is fundamentally different.

Some produce sweat more highly concentrated in chlorides than others. Such persons may show less muscular efficiency and greater exhaustion. Men in the desert are, therefore, encouraged to use salt liberally.

Acclimatisation to heat may enable men to withstand more dehydration but there can be no acclimatisation to dehydration.

The monograph is well illustrated with photographs, graphs, maps, etc., and contains numerous tables recording statistical data of great interest. It will be a valuable addition to any Library, general or scientific.

B. T. KRISHNAN.

**Acta Crystallographica.** Editor: P. P. Ewald. (Cambridge University Press.) Annual Subscription £2-10.

This is a bi-monthly journal sponsored by the International Union of Crystallography. The publication of the Journal is expected to begin early this year, and is intended to provide a medium for the publication and discussion of original research in crystallography in its broadest sense. It will concern itself with all those physical and chemical properties of matter intimately connected with atomic arrangement. It will, therefore, touch very closely the interests of the chemist, the physicist, the metallurgist, the mineralogist and the biologist.

The advisory board includes eminent crystallographers like Sir William Bragg and Prof. L. Pauling. The early issues will contain original articles by Lonsdale, Jerslev, Winkler and other distinguished workers in the field.

Contributions to the Journal will be accepted in English, French, German and Russian.

Crystallography is a rapidly expanding field of fundamental and applied research which has a large number of workers devoted to its study both in the Eastern and Western hemisphere. Contributions from these workers has long since formed a recognised branch of scientific research demanding a periodical publication devoted all to itself. The foundation of the *Acta Crystallographica* fulfils, therefore, a real need, and is sure to give further fillip to studies in crystallography in its various aspects. We wish our new contemporary every success.

## Publications Received

*India Meteorological Department, Scientific Notes.* Vol. IX, No. 109. "Inter-diurnal Variations of Pressure and Temperature in the Upper Atmosphere Over North India," by M. W. Chiplonkar. Published by the Manager of Publications, Delhi, 1947. Price Annas 14 or 1*sh*. 3*d*.

*India Meteorological Department, Scientific Notes*, Vol. IX, No. 113. "The Fan Type Radio Meteorograph of the India Meteorological Department," by S. P. Venkiteshwaran, R. P. Thatte and A. Keshavamurthy. Published by the Manager of Publications, Delhi, 1948. Price Rs. 1-10 or 2*sh*. 6*d*.

*India Meteorological Department, Scientific Notes.* Vol. IX, No. 114. "A Low Pressure Portable Hydrogen Generator for Pilot Balloon Observatories," by L. S. Mathur. Published by the Manager of Publications, Delhi, 1947. Price Annas 5 or 6*d*.

*Memoirs of the India Meteorological Department*, Vol. XXVII, Part IV. "On the Thermal Structure of the Atmosphere Over Agra," by R. Ananthakrishnan. Published by the Manager of Publications, Delhi, 1948. Price Rs. 2 or 3*sh*.

# SCIENCE NOTES AND NEWS

## S.-E. Asia Science Office

A Science Co-operation Office to serve as an information bureau for the nations of South-East Asia is being established in New Delhi by the U.N.E.S.C.O.

Dr. Alexander Wolsky, Hungarian Zoologist, will be in charge of the office which will serve India, Pakistan, Ceylon, Burma, Malaya, Singapore and Indonesia. An office in Nanking will cater to the interests of the Far Eastern countries.

The organisation will seek to bring scientists of South-East Asia into contact with one another and to make available to them the findings of scientists elsewhere in the world. The office will also serve as a bureau for the exchange of information and publications. Data will be available on scientific apparatus.

The Science Co-operation Office will work through institutes of science, universities and appropriate Government Ministries. The set up will comprehend all branches of Natural Science physics, chemistry, biology, mathematics, geology, geography, mineralogy and related subjects.

## Development of the Forest College at Coimbatore

An expansion of the Forest College at Coimbatore which, at the moment, provides only a Ranger's Training course, is contemplated by the Government of India. So far, Dehra Dun Forest College was the only centre in India, which provided facilities for higher training and research in Forestry. Officers for the Indian Forest Service were recruited from among the students of the Dehra Dun College. According to the present scheme, Coimbatore will have similar facilities and enjoy a higher status. The Institution will cater to the needs of South India and extend its hospitality to students from Ceylon, Malaya and Burma. It is hoped that Coimbatore which has built up a strong tradition for agricultural research and development will develop a strong school of research and tackle problems pertaining to economic products like sandal which constitutes an exclusive forest crop of the Deccan Plateau.

## Nuclear Physics at the Calcutta University

Early in 1940, the Dorabji Tata Trust, Bombay, generously donated Rs. 60,000 towards the cost of installing a cyclotron and at the time great hopes were entertained that radio-active isotopes would be made available to biochemists and medical men. For some reason or other these hopes have not yet been realised, and we are happy to learn that there has been revival of the proposal which, this time, appears to be taking a more practical shape.

The progressive Government of West Bengal have sanctioned a grant of 2 lakhs of rupees for an Institute dedicated to fundamental research in nuclear physics under the auspices of the University of Calcutta. Laying the Foundation Stone of the Institute, Dr. Shyama Prasad Mookherjee declared that India could not remain a mere spectator in the grand drama of human achievement, particularly when she had all the raw materials in plenty for the development of atomic energy. He hoped that within their own life-time, discoveries in this field might influence every phase of human life.

In a project of this kind it is not the funds nor the availability of raw materials which matters, it is the lack of trained personnel with practical knowledge and experience. The most effective way of meeting this deficiency and the one which is usually adopted by all progressive countries, is to invite a few eminent scientists from abroad for initiating and organising these studies. Such men are available and would be willing to accept such responsibilities for a short period. It is, however, a matter of some satisfaction that a good number of Indian scholars are now obtaining the necessary experience in the experimental aspects of nuclear physics, biochemistry and medicine, and it is hoped that these young and enthusiastic workers will constitute a brilliant team and build up a school of nuclear studies in this country.

## National Central Library for India

The Government of India have appointed an Expert Committee to consider and report on the advisability of establishing a National Central Library in India. It is proposed that one of the sections of this Library should be a Central Copyright Library to which a copy of all publications published in India will be sent.

Dr. Tara Chand, the Educational Adviser to the Government of India, is the Chairman of the Committee, and Mr. B. S. Kesavan, Librarian, Imperial Library, Calcutta, is the Secretary of the Committee.

The terms of reference of the Expert Committee are to consider and report on (*a*) the scope of legislation, if any, for establishing a National Central Library; (*b*) the functions of the Library; (*c*) the administration and staff, building, etc., needed; (*d*) finances; and (*e*) the relation of the National Central Library with (i) the Imperial Library, Calcutta, (ii) the Central Secretariat Library and other Central Government Libraries, and (iii) Provincial Libraries.

The Committee held its first meeting in Delhi in the first week of April.

## Drug Museum for India

A number of crude drugs of vegetable origin as well as a number of fixed and essential oils have been collected for the work of the

Indian Pharmacopœial List Committee of the Government of India. This collection with proper labelling and the herbarium sheets of most of them has been sent to the Director-General, Indian Medical Service, by Mr. S. N. Bal, a member of the Committee, to form the nucleus of a drug museum, according to the report of the Botanical Survey of India, for 1945-46.

Though the gallery of the Industrial Section of the Indian Museum, Calcutta, was closed to the public during this period, the Department continued to supply information regarding the botanical products of India to Military and Civil Hospitals, Medical Institutions and Industrial concerns.

## The Botanical Society of Bengal, Calcutta

The Annual Report for 1947-48 records the activities of the Society during the year which includes the presentation of seven original papers and the holding of a special symposium on the "Scope of Cultivation of Indigenous Medicinal Plants in India". The Society issued its first bulletin in April 1947 but due to "financial limitations", the second issue could not appear. We are afraid that the multiplication of journals in India in the present stage of our science, is undesirable; it is far wiser to make use of the existing journals, and extend our support to them. Individual societies can always obtain reprints of their contributions for distribution among their members. This procedure, if adopted, would prove economical and serve to consolidate the position of existing scientific journals in India.

## Zoological Society of India

The following Members of the Executive Council were elected at the annual meeting held at Patna in January 1948:—*President*: Dr. S. L. Hora; *Vice-President*: Prof. D. R. Bhattacharya: *Secretary*: Hon. Major Dr. M. L. Roonwal; *Editor*: Prof. K. N. Bahl; *Treasurer*: Dr. B. S. Chauhan; *Members*: Dr. N. K. Panikkar, Prof. M. A. Moghe, Dr. B. N. Chopra, Dr. Bhattacharya, Dr. G. D. Bhalerao, Dr. D. V. Bal, Dr. T. J. Job. It is intended to bring out the first volume of the *Journal of the Zoological Society of India* this year. Papers intended for publication, which should either be original contributions or critical reviews of current researches, not published elsewhere, should be sent either to the Editor (at the Zoology Department, Lucknow University, Lucknow) or to the Secretary (at the Zoological Survey of India, Benares Cantt.). Persons intending to become members should contact the Secretary.

## International Congress of Food and Agricultural Industries

The Seventh International Congress of Food and Agricultural Industries will meet in Paris between the 12th and the 18th July 1948, at the invitation of the French Government.

Monsieur André Mayer, Professor at the College de France, who is Chairman of the Executive Committee of the U.N.O. for Nutrition and Agriculture, will speak on "The Importance of Technical Developments in the Agricultural Industries in the Fight against Malnutrition". Monsieur Bossaert will deal with the problem of stabilising world prices of agricultural raw products.

The Congress will comprise more than thirty sections, dealing with problems of special urgency at the present time. Further details may be had from the Commission Internationale des Industries Agricoles, 18, Avenue de Villars, Paris; 51, Route de Frontenex, Geneva.

## Standardisation of Textiles

A delegation of Indian experts, led by Dr. L. C. Verman, it is understood, will be shortly attending a meeting of the International Committee on Textiles, which is an auxiliary body of the International Organisation for Standardisation (I.S.O.). The meeting of the Committee will be held at Buxton (U.K.) on June 14, a day prior to which the Indian Delegation will participate in the Annual Convention of the British Textile Institute. Dr. Verman is also expected to extend his tour to the U.S.A., and Canada with a view to studying at first hand the standardisation activities of the National Standards Bodies of these countries.

## Aerosporin for Whooping Cough

Recent work on Aerosporin, isolated from bacillus aerosporus, has shown that this antibiotic is more potent against whooping-cough than *streptomycin* and *sulphonamides*. The clinical dosage of Aerosporin has no apparent toxic effects, and the bacteria develop very little resistance to the antibiotic. This is a great advantage not possessed by most other antibiotics. The drug is being now manufactured in Britain.

## Dr. S. R. Ranganathan

The British Council has invited Dr. S. R. Ranganathan to visit the United Kingdom as its guest for two or three months this year. Dr. Ranganathan, who will be leaving India at about the end of May, will also visit France and the Netherlands.

While in England, Dr. Ranganathan will visit the most important British libraries and will study the National and County Central Library schemes in operation. He will also teach at the UNESCO Library Summer School, to be held in Manchester in September.

Editor: M. Sreenivasaya, B.A., F.I.I.Sc., F.A.Sc.
472-18 Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore

# Current Science

Vol. XVII] JUNE 1948 [No. 6



## INDIAN MEDICINE

INTEREST in the indigenous system of medicine—Ayurvedic, Unani and Tibbi—has been roused for the past 100 years or more. The revival of this system has been engaging the attention of experts, enthusiasts and the Government for some time now. As early as 1845, Dr. T. A. Wise drew the attention of the Western World to the merits of the ancient Hindu system of medicines. Later on, at the Medical Congress held in Calcutta during 1894, interest in this subject was revived. The Government of India also appointed a Committee to go into the question of the desirability of extending the use of Indigenous Drugs in India and recommend ways and means of popularising this system.

As a result, study in the indigenous system of medicine was started at the School of Tropical Medicine, Calcutta, by Col. Sir R. N. Chopra and also at the Haffkine Institute at Bombay. A modest beginning was made at Calcutta in 1921 and it was not till 1926, when the Indian Research Fund Association gave a grant, that investigations were taken up in right earnest. Very little encouragement was, however, forthcoming from the Government as then constituted on account of the vested interest in the allopathic system. The interest of the Government was therefore confined only to the exploitation of the indigenous drugs for the benefit of the foreign pharmaceutical concerns. But in spite of the lack of encouragement, the investigations into the rationale of the indigenous system of medicine at the School of Tropical Medicine and at Haffkine Institute, were appreciated more and more. During recent years, Mysore, Travancore, Madras and Banares have taken a prominent part to revive the glory and usefulness of the indigenous system. Recently (1947) the National Government of India has appointed the Chopra Committee to recommend steps to promote research in the indigenous medicine. The Committee have gone round the country, collecting evidence from individuals and exponents of this system and their report is eagerly awaited.

The ancient Hindu system made considerable progress in the science of medicine and this is fully acknowledged by the

savants who have studied both the Western and Eastern systems. The efficacy of any system is best proved by the cures they effect and the large number of Ayurvedic and Unani physicians practising bears testimony to the value of these systems.

Nevertheless, our knowledge of ancient Hindu medical system at present, is limited. Indian medicine of an earlier period ("Charaka" and "Susruta" 800-700 B.C.) was, however, not only cognisant of the Hippocratic doctrine regarding many drugs and diseases but was also developed through keen observation, induction and deduction—a sound basis for pharmacy and therapeutics. Probably it will be a surprise to many when they discover the amount of anatomical knowledge which is contained in the works of the earliest medical writers in India. No satisfactory knowledge of human anatomy can be attained without recourse to dissection and we have direct proof of such practice in the medical compendium of "Susruta" and it is indirectly confirmed by the statement of "Charaka".

The literature extant on the ancient system bears testimony to the fact that practice of both medicine and surgery had attained its zenith of development. A close study of the literature of ancient period reveals the extent of scientific knowledge regarding diagnosis and treatment of diseases then prevalent. "Susruta" devotes two chapters (the seventh and eighth of the Sutra Sthana) to the discription of surgical instruments and one chapter (the twenty-fifth) to the principles of surgical operations.

Time has now arrived to acknowledge the merits of the ancient system in the light of the latest knowledge in medical and allied sciences.

The indigenous systems of medicine minister to the needs of 80 per cent. of the population of India at the present time, particularly in the rural area. The popular view is therefore, that this system should not be excluded from the field of medicine. Chopra (Indigenous Drugs Enquiry — a review of the work—July 1939) has pointed out that it should be used to the best advantage while the rationalisation of the system is being worked out. The rationalisation should consist of the evolution of a country-wide extension of the system which can be regarded in the words of the Bhore Committee "neither as Eastern nor Western but is a corpus of scientific knowledge and practice belonging to the whole world in which every country has made its contribution"

Anything which is valuable in any system has to be pooled and placed at the services of suffering humanity. India can ill-afford to run diverse systems of medicine, side by side, and we have to evolve a system of medicine, based on rational lines. Col. Chopra, who has spent his life-time on this subject, has very clearly brought out the role of indigenous medicine and its synthesis with modern system in his Presidential Address at the 35th Indian Science Congress. What the Indian systems could indeed adopt is the scientific approach to the problem—from the empirical knowledge of a crude drug to its use as a rational scientific medicine. It must pass through (1) botanical identification of the medicinal plants, (2) a thorough chemical examination of their active ingredients, (3) pharmacological and toxicological investigation and finally (4) clinical trial. The indigenous systems must seek rational explanation for all physiological and pathological phenomena. Additional knowledge of anatomy, physiology and pathology would certainly provide a better understanding of the theory and practice of the indigenous system and would inculcate in the practitioners an essential scientific outlook.

Evidence has been placed before the Chopra Committee emphasising the need for comprehensive research on the indigenous system. It is hoped that the proposed Central Drugs Research Institute will ensure the fullest collaboration between all the allied sciences concerned in drug research. An Indian Pharmacopœia should be prepared, the object of which should be to select drugs whose medicinal properties have been established and to prepare suitable compositions of the drugs for the best advantage. Such a scientific pharmacopœia should consist of all the useful knowledge of Ayurvedic, Unani and Allopathic systems. This would automatically remove the barriers that now exist between the different systems. We are confident that the Chopra Committee will give their earnest consideration to these and many other problems connected with the subject and lay the foundation for the revival of the Indian system of medicine, so that its future will be even brighter than its past.

# MODE OF ACTION OF VITAMIN D—A RESUMÉ

V. N. PATWARDHAN

(*Nutrition Research Laboratories, Indian Research Fund Association, Coonoor*)

THE discovery of vitamin D as the specific etiological agent in rickets was an event of great significance to the science of nutrition. It led to intensive investigations on the occurrence, properties, isolation and preparation of vitamin D in the pure state. At the same time the physiological function of vitamin D and prevention and treatment of rickets were being studied by different groups of workers. After nearly thirty years of work, more than ten substances with varying vitamin D activity have been discovered, of these vitamin $D_2$ and $D_3$ are the most important. Although much valuable information on the biological side has been added during the same period, vitamin D is one of the few known vitamins about the mode of action of which there is very little definite knowledge.

Cod-liver oil had been in use for medical purposes[1] since 1789 ; its use for rickets was first reported in 1824. It was in 1909, however, that any indications of the mode of its action became available when Schabad[2] reported his classical experiments on the effects of cod-liver oil on calcium and phosphorus metabolism in rickets. In 1919 Mellanby[3] found that cod-liver oil was effective in curing rickets experimentally produced in puppies. McCollum[4] and others (1921) demonstrated the curative action of the oil in rat rickets ; from the same laboratory came the first proof of the presence of a fat-soluble vitamin in cod-liver oil in addition to vitamin A discovered earlier.

The observation of Huldschinsky[5] (1919) on the therapeutic effect of ultra-violet rays in infantile rickets started another series of researches in a number of laboratories culminating in the isolation of calciferol in pure form in 1932 by Askew *et al.*[6] and Windaus[7] *et al.* with an activity of 40,000 I. U. per mgm. of the crystalline material. Calciferol or vitamin $D_2$ is a product obtained on irradiation of ergosterol. Soon it was proved that calciferol was not the naturally occurring vitamin D found in the liver oils or the one generated in the skin by the action of ultra-violet rays. An irradiated product of 7-dehydrocholesterol was identified as the natural vitamin (Bills,[8] 1938) and is now known as vitamin $D_3$ having an antirachitic activity for rats comparable with that of calciferol.

The progress in the knowledge about the mechanism of action of vitamin D did not, however, keep pace with that on the chemical side. Only two definite results have emerged thus far as a result of intensive studies carried out by numerous workers. The first is that in therapeutic doses, vitamin D promotes retention of calcium and phosphorus, particularly in rachitic animals and the second, that vitamin D, also in therapeutic doses, cures rickets by permitting calcification of the bone to proceed in a normal manner. An adequate supply of vitamin D to the young animal can prevent the onset of rickets. These manifestations however, are the end results of vitamin D action. They do not throw much light on how the action is brought about. Certain hypotheses have been put forward to explain the action. They are not entirely satisfactory but are currently accepted for want of more convincing explanation. It is therefore the aim of this article to review in brief the evidence for and against these hypotheses with a view to indicating further lines of attack which may possibly lead to a better understanding of the mode of action of vitamin D. So much work on the subject has been published that it would be impossible to deal with all of it in this article. An attempt has therefore been made to cite some of the more important references which have largely contributed to the present state of our knowledge regarding vitamin D.

As mentioned earlier, Schabad was the first to demonstrate that in rachitic infants, the administration of cod-liver oil increased the retention of calcium and phosphorus. Findlay, Paton and Sharpe[9] (1920-22) suggested that the increased loss of calcium through the fæces was due to the fact that calcium was not properly utilised in the body of the rachitic children and hence was re-excreted in the digestive tract. Telfer[10] (1922-23) and Orr, Holt, Wilkins and Boone[11] (1923-24) also observed diminished retention of calcium and phosphorus in clinical rickets. Further metabolic studies by Telfer[12] (1926) using cod-liver oil and of Hottinger[13] (1929) using irradiated ergosterol brought out the fact that under the influence of vitamin D there was a shift from fæces to urine in the excretion of calcium and phosphorus. Watchorn[14] (1930) reported a decrease in the fæcal calcium and phosphorus of rachitic rats after administration of irradiated ergosterol. A reduction in calcium excreted with the fæces of rachitic rats administered irradiated ergosterol was also observed by Kern, Montgomery and Still[15] (1931) and Harris and Innes[16] (1931). Such observations inevitably pointed to the conclusion that vitamin D favoured the absorption of calcium and/or phosphorus from the gut. It must be pointed out that these conclusions were based on studies in which the sum of calcium and phosphorus elimination in urine and fæces was compared with the intake of these elements. Such balance studies are expected to yield correct information only when there is no re-excretion in the gut of the substances absorbed from the upper reaches of the small intestine. When such is not the case, the interpretation of balance studies would lead to erroneous conclusions regarding the process of absorption. There is a certain amount of evidence to show that calcium and phosphorus, both are re-excreted into the intestine. This fact was taken into consideration by Harris[17] (1932) when he suggested the use of "net absorption" to indicate the difference between the intake of calcium and the sum of urinary and fæcal calcium. But other authors were

less careful in the use of the term absorption, and it has come to be accepted that vitamin D increased specifically the absorption of calcium from the intestine.

In 1926, Bergeim[18] introduced $Fe_2O_3$ together with calcium salts in the intestine and determined the ratio of Fe to Ca at various levels of the small intestine. He came to the conclusion that deficiency of vitamin D did not adversely affect the absorption of calcium. Taylor and Weld[19] (1932) also reported that vitamin D had no influence on calcium absorption. Nicolaysen[20] (1937) was the first to seek direct proof of the effect of vitamin D on absorption of calcium from the small intestine. He used the isolated loop technique of Verzar[21] (1936) and showed that in rachitic rats, the rate of absorption of calcium was slower than in the animals protected against rickets by vitamin D. Nicolaysen's results found wide and uncritical acceptance. When Patwardhan and Chitre[22] (1942) studied the absorption of calcium in three groups of rats which were (*a*) rendered rachitic, (*b*) protected against rickets by dosage with vitamin D and (*c*) rendered hypervitaminotic by massive dosage with vitamin D respectively, they could find no significant difference in the rates of absorption of calcium from the small intestine among the rats belonging to these groups.

Thus, it cannot be denied that in spite of clear-cut evidence that in therapeutic doses vitamin D increases calcium and phosphorus retention, no direct evidence of its effect on absorption from the intestine has yet been forthcoming [Wolbach[23] (1947)]. Hence no definite conclusion can be reached with regard to the mechanism by which vitamin D increases the retention of calcium and phosphorus.

It will be of interest now to discuss other manifestations of vitamin D action, particularly those affecting blood and the bone. A deficiency of vitamin D is responsible for infantile rickets (Hess[27]; Eliot and Park, *loc. cit.*). It is also responsible for experimentally produced rickets in animals (Mellanby, 1919, *loc. cit.*, and McCollum, *et al.*, 1921, *loc. cit.*). The levels of calcium and inorganic phosphorus in the serum of normal children are roughly between 10–12 mg. per cent. and 4 to 6 mg. per cent. respectively (Howland and Kramer,[24] 1923; Patwardhan, Chitre and Sukhatankar,[25] 1944). In rickets, Ca or inorganic P[24a] or both may fall below normal levels. Eliot and Park[26] (1942) state that in rickets serum calcium remains at approximately the normal level, but the inorganic phosphorus decreases considerably. They do mention the possibility, however, that calcium and not the inorganic phosphorus may be decreased. Patwardhan, Chitre and Sukhatankar (*loc. cit.*) found a greater frequency of low calcium levels than of low inorganic phosphorus in radiologically diagnosed rickets studied by them in a hospital in Bombay. What the predisposing conditions are which determine the lowering of calcium or phosphorus or of both is not yet quite clear. Whatever the condition, the administration of vitamin D in therapeutic doses, brings about a return to the normal, both in clinical as well as in experimental rickets. These changes in the blood are, however, reflected in the composition of bone. The fact that rachitic bone is poorly calcified is too well known to require elaborate description The response of rachitic animals to vitamin D resulting in increased calcification has been the basis of several methods of vitamin D assay.

There are reasons to believe that there is nothing inherently wrong with the rachitic bone. Shipley, Kramer and Howland[28] (1926) showed that slices of tibiæ from rachitic rats calcified when immersed in an inorganic solution of known composition containing Ca and inorganic P. The product of Ca and P determined whether calcification would take place or not. They also demonstrated that rachitic bone slices would not calcify in the serum of rachitic animals whereas they would if immersed in the serum of non-rachitic animals. Robison and his colleagues [Robison and Soames[29] (1930), Robison, McLeod and Rosenheim[30] (1930)] demonstrated that in the presence of organic phosphoric esters, rachitic bone would calcify *in vitro* with lower concentration of inorganic P. It is permissible to assume therefore that in rickets, bone does not calcify because the fluid environment in the immediate vicinity of the zone of provisional calcification is not suitable for promoting bone formation. Since the interstitial fluid should be in equilibrium with blood, the defect must primarily be looked for in the blood itself.

The interrelation between the mineral composition of bone and the electrolyte composition of plasma has been the basis of much work and certain hypotheses have been put forward to explain the normal process of calcification. In the main, these hypotheses postulate that when the plasma is in a state of supersaturation with respect to $Ca_3(PO_4)_2$ and/or $CaHPO_4$ the bone salt is laid down. The latter has the composition $n$ $Ca_3(PO_4)_2$. CaX where X may be $F^-$, $OH^-$, or $CO_3^{=}$ and the value of $n$ may vary between 2 and 3. Holt, Lamer and Chown[31] (1925) suggested that $Ca_3(PO_4)_2$ was laid down when the concentration of $[Ca^{++}]^3$ and $[PO_4^{\equiv}]^2$ in serum exceeded the solubility product. Wendt and Clarke[32] (1923) had made a suggestion that $CaHPO_4$ and not $Ca_3(PO_4)_2$ was the salt first precipitated, a hypothesis which received support from Shear and Kramer[33] (1928). Logan[34] (1940) reviewed the evidence in support of both these hypotheses including the work done by him and his colleagues and came to the conclusion that the salt first precipitated probably had the composition of $CaHPO_4$; the alteration in composition to that more commonly known was achieved by the exchange of ions. Additional evidence in favour of this hypothesis was given by freeman and McLean[35] (1941) who found that in rachitic puppies, the blood was undersaturated with respect to $CaHPO_4$ although it was not necessarily so with respect to $Ca_3(PO_4)_2$. Patwardhan, Chitre and Sukhatankar[36] (1945) also observed a similar state of affairs in experimental rickets in puppies as well as in clinical rickets in Indian infants and children. Patwardhan and Dikshit[37] (1946) followed up these observations by determining the changes

in the ionic concentration of $Ca^{++}$, $HPO_4^{=}$ and $PO_4^{\equiv}$ during the onset, progress and healing of rickets in puppies. They found that the process of healing indicated by radiological examination was simultaneous with or most probably preceded by a shift to the state of supersaturation with respect to $CaHPO_4$ and $Ca_3(PO_4)_2$ both. Whichever the salt that is precipitated to start with (a matter not unimportant in itslf, but immaterial for the purposes of this article) it is clear that in a deficiency of vitamin D, the blood is undersaturated with respect to $CaHPO_4$ and probably also $Ca_3(PO_4)_2$, and on administration of adequate amounts of vitamin D, the serum becomes supersaturated initiating the healing of the rachitic lesion. Here again one sees the result, but the mechanism by which it is brought about remains obscure.

The curative effect on rickets shown by vitamin D is accompanied by an increase in the serum Ca or inorganic P or both. But this cannot be the only consideration in initiating repair of a rachitic bone. Nicholaysen[38] (1939) has reported that increasing the serum concentrations of Ca and inorganic P by intravenous injections did not lead to normal bone formation in rachitic animals in absence of vitamin D. It appears therefore that vitamin D influences bone formation in some other way as yet unknown. Besides, the supersaturation theory does not explain all the known facts. Firstly, bone is continually undergoing change in which the processes of demineralisation and mineralisation presumably alternate. During the growth period, it is the latter process which predominates and the bone finally assumes the shape found in the adult. During senility, it is presumably the demineralisation that assumes the upper hand, and bone in old age tends to become osteoporotic. It will not be possible to explain adequately these phenomena unless one assumes locally produced alternate stages of undersaturation and supersaturation. That bone is in a dynamic state has been beautifully demonstrated by Chiewitz and Hevesy[39] (1935) by the use of $P^{32}$.

The action of vitamin D when administered in massive doses is also difficult to explain. Hypervitaminosis D is a condition in which there is first *hypercalcæmia* and *hyperphosphatemia* accompanied by increased excretions of Ca and P in urine and decreased fæcal excretion of these elements. In the early stages of hypervitaminosis D, there is thus increased retention of Ca and P. When the condition becomes severe, the retention of these elements may actually decrease. It has been suggested by Harris and Innes[16] (1931) that in severe hypervitaminosis the gut function fails and hence there is decreased absorption of calcium from the intestine. Patwardhan and Chitre[22] (1942) however found, as mentioned before, that in animals with severe induced hypervitaminosis D showing decreased retention, there was no significant difference in the absorption of calcium from the intestinal loops as compared with the absorption in normal animals.

So far as bone is concerned, intense calcification is observed in early stages of hypervitaminosis D. When the condition becomes severe, demineralisation of bone takes place (Brown and Shohl,[40] 1930; Harris and Innes,[16] 1931; Patwardhan and Chitre,[41] 1938). Strangely enough this withdrawl of calcium from bone occurs with or without dietary calcium and results in a high concentration of Ca and inorganic P in blood. This latter condition may lead to metastatic calcification of soft tissues.

The observations of Ham and Lewis[42] (1934) are particularly interesting; they found that when massive doses of vitamin D were administered to young rats, a condition in epiphyseal cartilage resembling that found in low calcium rickets was produced. Thus here is an example where excess of vitamin D actually prevents calcification of the growing bone. The toxic effects of vitamin D on bone are exactly opposite of what they are when the vitamin is administered in therapeutic doses.

It must be pointed out that vitamin D has no local action (Robison and Rosenheim,[43] 1934) at the seat of calcification. Its systemic action consists, in addition to what has been described above, in a *reduction* of plasma phosphatase if it had increased due to rachitic lesion (Bodansky and Jaffe,[44] 1934) and an increase to normal of certain phosphoric esters of the red blood cell (Rapoport and Guest,[45] 1938). No other changes in blood have been reported either in rickets or in hypervitaminosis D which could be ascribed to the latter.

The delay in the manifestation of vitamin D action after its administration raises the question whether the vitamin undergoes any change in the body before exerting its characteristic actions. There is some circumstantial evidence in support of this concept, enough to warrant further exploration. It is well known that in a rachitic animal, the healing effect of vitamin D can be demonstrated only 24 to 48 hours after administration. Irving[46] (1944) found teeth more sensitive to vitamin D action than long bones; but in teeth too, the action was manifest only after 24 hours. Morgareidge and Manley[47] (1939) reported that the amount of $P^{32}$ in the metaphyses of rachitic rats increased after 54 hours after the adminstration of $P^{32}$ and vitamin D and that this increase coincided with the appearance of the healing line in the epiphyseal cartilage. In certain experiments carried out by the author (unpublished) it was found that even intravenous administration of 4,000,000 I.U. of vitamin $D_2$ to dogs of 11 to 12 kgm. weight caused a rise in serum calcium only after 24 hours. Against this can be mentioned the fact that the hypercalcæmic action of parathyroid hormone is manifest within a few hours and the blood calcium may return to normal within 24 hours. The delay in vitamin D action has been attributed to the possible intervention of parathyroids, for it has been suggested that vitamin D acts by stimulating parathyroids to greater activity, a suggestion which still remains to be proved. Vitamin D can act in absence of or in case of hypofunction of parathyroids and can actually relieve parathyroprivic tetany (McLean,[48] 1941; Drake and Sulkowitch,[49] 1938).

The idea that vitamin D may undergo some change in the body before exhibiting its activity

is not so far fetched as it seems. The functions which some other vitamins perform in the body are carried out in combination with proteins and certain other substances. Vitamin A, thiamine, riboflavin and nicotinic acid are the best examples of this type. Even if the above suggestion proved to be correct, there still would remain the need to find out the way in which the hypothetical derivative or compound of vitamin D would exert its action. Thus far then, there is no clue to the mode of action of vitamin D. Recent work with the radioisotopes of Ca and P with or without vitamin D has confirmed some of the earlier findings without adding anything fundamentally novel. It is a permissible conjecture that labelling of vitamin D itself, if that were possible, would yield much more valuable information on the subject.

It is difficult, however, to predict the direction which future work on vitamin D would take. There appear several possibilities which could be explored, *e.g.*, (1) search for the hypothetical vitamin D compound, (2) more precise information about the fate of vitamin D in the body and (3) preparation of simpler compounds possessing vitamin D activity.

Investigations along the lines suggested above are already in progress in some laboratories in India and abroad, and it is expected that, if successful, they will yield much needed information on the mode of action of vitamin D.

Work on vitamin D has been very much hampered by the lack of suitable physico-chemical or chemical methods of assay. Biological methods are the only methods available at present which can be relied upon to give reasonably accurate results. These are tedious, time-consuming and require large numbers of animals. Colorimetric methods have been suggested from time to time, but they fail because they are either non-specific or require large concentrations of vitamin D to be effective. Unless this obstacle is removed from the path of investigators, further progress is bound to be slow.

1. McCollum, E. V., Orent-Keiles, E., and Day, H. G., "The Newer Knowledge of Nutrition," Macmillan Co., New York, 1939. 2. Schabad, 1909. Quoted from Hess, A. F., "Rickets, Osteomalacia and Tetany," Henry Kimpton, London, 1930. 3. Mellanby, E., *Medical Research Council, Special Report*, 1919, No. 38. 4. Shipley, P. G., Park, E A., McCollum, E. V., Simmonds, N., and Parsons, M. T., *Journal of Biological Chemistry*, 1921, **45**, 343. 5. Huldschinsky, K., 1919. Quoted from Hess, A. F., 1930. 6. Askew, F. A., Bourdillon, R. B., Bruce, H. M., Callow, R. K., Philpot, J. St., and Webster, J. A., *Proc. Roy. Soc. London*, 1932, **109**, 488. 7. Windaus, A., Linsert, O., Luttringhaus, H., and Wiedlich, G., *Annalen.*, 1932, **492**, 226. 8 Bills, C. E., *J. Amer. Med. Assoc.*, 1938, **110**, 2150. 9. Findlay, L., Paton, D. N., and Sharpe, J. S., *Quart. J. Med.*, 1920–21, **14**, 354. 10. Telfer, S. V., *Ibid.*, 1922-23, **16**, 63. 11. Orr, W. J., Holt, L. E., Wilkins, L., Boone, F. H. *Amer. J. Dis. Child.*, 1923–24, **26**, 362 and **28**, 574. 12. Telfer, S. V., *Quart. J. Med.*, 1926, **20**, 7. 13. Hottinger, A., *Ztschr-f-kinderheilk*, 1929, **47**, **341**. Quoted from Hess, A. F., 1930. 14 Watchorn, E., *Biochem. J.*, 1930, **24**, 631. 15. Kern, R., Montgomery, M. F., and Still, E. H., *J. Biol. Chem*, 1931, **93**, 365. 16. Harris, L. J., and Innes, J. R M., *Biochem. J.*, 1931, **25**, 367. 17. Harris L. J., *Lancet i*, 1932, 1031. 18. Bergeim, O., *J. Biol. Chem.*, 1926, **70**, 51. 19. Taylor, N. B., and Weld, C. B, *Brit. J Exper. Path.*, 1932, **13**, 109. 20. Nicolaysen, R., *Biochem. J*, 1937, **31**, 323. 21. Verzar, F., "Absorption from Intestines," Longmans, Green & Co., London, 1936. 22. Patwardhan, V. N., and Chitre, R.G., *Indian J. Med. Res.*, 1942, **30**, 1. 23. Wolbach, S. B., *Nutr., Rev.*, 1947, **5**, 159. 24. Howland, T., and Kramer, B., 1923. Quoted from Eliot and Park, 1942 24*a*. Howland, J., and Kramer, B., *Amer. J. Dis. Child.*, 1921, **22**, 105 25. Patwardhan, V. N., Chitre, R. G., and Sukhatankar, D. R., *Indian J. Med. Res.*, 1944, **32**, 31. 26. Eliot, H. M., and Park, E. A., Brennemann's "Practice of Pediatrics," 1942, Vol. I, Chap. 36. 27. Hess, A. F., "Rickets, Osteomalacia and Tetany," Henry Kimpton, London, 1930. 28. Shipley, P. G., Kramer, B., and Howland, J., *Biochem. J.*, 1926, **20**, **379**. 29. Robison, R., and Soames, K. M., *Ibid.*, 1930, **24**, 1922 30. Robison, R., McLeod, M. and Rosenheim, A. H., *Ibid.*, 1930, **24**, 1927. 31. Holt, L. E., Lamer. V. K., and Chown, H. B., *J. Biol. Chem*, 1925, **64**, 509. 32. Wendt, G. L., and Clarke, A. H., *J. Amer. Chem. Soc.*, 1923, **45**, 381. 33. Shear, M. J, and Kramer, B., *J. Biol. Chem.*, 1928, **79**, 125. 34. Logan, M. A., *Physiol. Rev.*, 1940, **20**, 522. 35. Freeman, S., and McLean, F. C., *Arch. Path.*, 1941, **32**, 387. 36. Patwardhan, V. N, Chitre, R. G., and Sukhatankar, D. R., *Indian J. Med. Res*, 1945 **33**, 195. 37. Dikshit, P. K., and Patwardhan, V. N., *Ibid.*, 1946, **34**, 263. 38. Nicolaysen, R., *Acta Pædiat.*, 1939, **24**, 368. Quoted from *Ann., Rev. Biochem.*, 1940, **9**, **357**. 39. Chiewitz, O., and Hevesy, G., *Nature*, 1935 **136**, 754. 40. Brown, H. B., and Shohl, A T., *J. Biol Chem.*, 1930, **86**, 245. 41. Patwardhan, V. N., and Chitre, R. G., *Indian J. Med. Res.*, 1938, **26**, 447. 42. Ham, A. W., and Lewis, M. D., *Brit. J. Exper. Path.*, 1934, **15**, 228. 43. Robison, R., and Rosenheim, A. H., *Biochem. J.*, 1934, **28**, 684. 44. Bodansky, A., and Jaffe, H. L., *Amer. J. Dis. Child*, 1934, **48**, 1268. 45. Rapoport, S., and Guest G. M., *J. Biol. Chem.*, 1938, **126**, 749. 46. Irving, J. T., *J. Physiol.*, 1944, **103**, 9, 1944. 47. Morgareidge, K., and Manley, M. L., *J. Nutr.*, 1939, **18**, 411 48. McLean, F. C., *J. Amer. Med. Assoc.*, 1941, **117**, 609. 49. Drake, T., and Sulkowitch, H. W., *J. Clin. Invest.*, 1938, **17**, 317.

*N.B.*—The cost of printing this article has been met from a generous grant received from the National Institute of Sciences, India.

# INTERNATIONAL DEPOT OF MICROSCOPIC PREPARATIONS OF CYTOLOGY CREATED BY THE INTERNATIONAL UNION OF BIOLOGICAL SCIENCES

## An Appeal to Cytologists

IN 1939, the International Union of Biological Sciences requested Professor P. Martens, Director of the J. B. Carnoy Institute, at Louvain, Belgium, to take up again, the project of an International Depot of Microscopic Preparations of Cytology, animal and vegetable. This plan had previously been submitted by the Union to the late Prof. V. Gregoire ; but owing to his poor health condition, he was unable to realize the practical side of this plan. On the other hand, the International situation, and the state of war, have delayed until to-day the announcement of the creation of this organisation.

It would therefore be a matter of assembling together at an easily accessible centre the laboratory of Cytology of the *Carnoy Institute*, at *Louvain* (Belgium) — preparations obtained from numerous research centers, and having already been used as basis to previously published contributions. Each worker, interested in a definite problem, could thus locate and compare with his own documentation, the original microscopic preparations of other authors pertaining to the subject. It is hardly necessary to underline the considerable interest that a Depot of this kind would acquire a good understanding amongst workers which it would promote. The depot will serve to vain contestations, settle differences of opinion which arise and often burden the scientific litearature

But this result can only be obtained with the greatest comprehension and collaboration of the greatest possible number of cytologists. I.U.B.S. invites all cytologists therefore, from now onwards to send their works to the Laboratory, and to enclose with them several preparations having already been used as basis of publications and to refer to such deposits in future. It is *desirable* that the spots considered by authors as particularly demonstrative or used as published illustration—should be specially noted on the preparations as clearly as possible. It is also requested that a reprint of the published work should be sent.

Every Biologist, known for his publications — and any other person, possessing an authorized recommendation—will be able to consult and study as much as they like, all preparations which have been entrusted to the Depot ; the consultants will have at their disposal, the Laboratory, the equipment and necessary optical instruments. All work must be done within the Depot, except in cases, when a written permission is granted by the depositor.

The preparations will always remain the entire *property of the depositors*, who can, at any time, have them sent back to them, the cost of postage would then be paid by the administration of the Depot.

Prof. P. Vayssiere (Paris)
The Secretary-General of the I.U.B.S.
Prof. P. Martens (Leuvain)
The Administrator of the Depot.

---

# HARWELL ATOMIC PILE

THE new atomic pile at Harwell (Berkshire) is expected to come into operation this summer when a much larger number of radioactive isotopes, with greater strength, will be produced than at present with the low-energy experimental pile, announces the Ministry of Supply.

It is estimated that this increase in production will be sufficient to meet the demands for radio-active isotopes of all research workers throughout Great Britain.

Processing, packing, and distribution of isotopes produced at Harwell will be carried out by the Radio-chemical Centre at Amersham. A statement will be issued in the near future on the services to be provided by this Centre, as regards distribution of both natural and artificial radio-active substances.

An initial supply of these isotopes was needed before the new pile came into operation, and as supplies from abroad were uncertain it was decided last July to try and supply these materials from the Gleep (Graphite Low Energy Experimental Pile) which was then nearing completion. The Gleep began to operate in August, and by the end of September the apparatus for handling the isotopes had been rushed through the workshops at Harwell.

As a result, production of radio-isotopes was started almost at the same time as the pile worked up to its rated power of 100 kilowatts. The first delivery of radio-iodine, urgently required for an operation at a Liverpool hospital, was made to the Medical Research Council on September 28, 1947.

The monthly production total of radio-isotope samples reached 120 in March of this year, of which one-third was used at Harwell. The remainder went to hospitals and research laboratories all over the country.

## 30,000,000 VOLT SYNCHROTRON

JUST delivered to the Natural Philosophy Department of Glasgow University is a 30,000,000—volt Synchrotron, made at Malvern (Worcestershire) by the Electronics Division of the Atomic Energy Research Establishment. The machine, which is to be used for research in nuclear physics, is expected to be in full operation this summer. It is of moderate size, being some six feet high, six feet wide and three feet deep, and weighs about five tons; and is later to be replaced by a larger machine, working at 300,000,000 volts, which is now being built in Manchester.

The Synchrotron consists essentially of a largo electromagnet, supplied with current from the mains. Between the poles of the magnet rests the "doughnut", a hollow ring, shaped vessel of ceramic material. Electrons given off by a red-hot wire inside the doughnut, travel round and round in a circle eight inches across, gaining speed at each revolution until they have energy corresponding to 30,000,000 volts. They are then allowed to spiral inwards, striking a metal target, from which very penetrating gamma rays are emitted. It is hoped later to extract the electron beam itself, though this is an operation of considerable difficulty.

The present instrument is one of a large battery of machines now being assembled by Professor Dee and his colleagues for research into the fundamental properties of nuclear particles.

## VIIth INTERNATIONAL CONGRESS OF AGRICULTURAL INDUSTRIES

THE French Government has invited the VIIth International Congress of Agricultural Industries to meet in Paris from the 12th to the 18th of July 1948.

The material organisation of this Congress is the respensibility of the French Ministry of Agriculture, whilst the scientific and technical direction of the meeting belongs to the International Commission of Agricultural Industries.

Convinced that the advancement of science and industry can only be properly served by the serious study of a limited number of scientific and technical questions, this Commission have decided which subjects should be those of a general type on which Reports are to be presented to the Congress, drawn up by highly qualified international personalities. In addition there will be Communications confined to the study of particular points of these questions.

Communications from Members of the Congress, presenting a particular interest for one or other of the specialised sections will always be received favourably, but they should nevertheless be submitted for approval, to the competent section of the technical Organisation Committee and of the Executive Committee specially appointed for this work.

There will be general meetings, special section meetings, and combined meetings of several sections for the discussion of scientific questions likely to interest a group of industries.

In connexion with the Congress may be held an international exhibition of laboratory apparatus and instruments, as well as of all equipment likely to interest the industries coming within the scope of the Congress. This exhibition could include photographs, plans, sketches, sections, etc. of the various items of apparatus which, for any reason, could not be shown, and also laboratory products.

The Congress will open on *Monday July 12th*, and will finish on *Saturday July the 17th, 1948*. Further particalars may be had from the General Secretary, 18 Avenue de villars, Paris 7.

## EXPENDITURE ON UNIVERSITY EDUCATION

IN the course of his address to the Special Convocation of the University of Patna held on 13-4-1948, Lord Louis Mountbatten said:—

"Finance has been a vexed question almost everywhere and particularly during the period of these two world wars. A recent British Committee on Post-war university education, for example, felt it necessary to complain that the total grant for the universities in the United Kingdom was the cost of four hours of war, and that expenditure on university education would give a better national dividend than on most forms of public works. What is true in the United Kingdom is even more true in India."

# LETTERS TO THE EDITOR



## PRACTICAL NUMBERS

THE subdivisions of money, weights and measures involve numbers like 4, 12, 16, 20 and 28 which are usually supposed to be so inconvenient as to deserve replacement by powers of 10. It was thought that these numbers can have no important feature to justify their existence except, perhaps, a fairly high composite character. In this note we proceed to show that they have a very remarkable property which ought to have been perceived by the ancients but either forgotten or ignored by the moderns. The revelation of the structure of these numbers is bound to open some good research in the theory of numbers. A preliminary examination is attempted here.

A number $N$ may be called a 'practical number (on account of the association aforesaid) if every number less than $N$, other than a factor of $N$, admits of partition into unequal parts all of which are factors of $N$. Thus the numbers less than 12, which are not factors of 12, are $5(=1+4=2+3)$, $7(=1+6=3+4)$, $8\ (=2+6)$, $9\ (=3+6)$, $10\ (=4+6)$, and $11\ (=1+4+6)$, where 1, 2, 3, 4 and 6 are factors of 12. 12 is therefore a 'practical' number.

It is easily seen that every 'practical' number greater than 2 must be a multiple of 4 or 6.

It cannot be a deficient number, that is one of which the sum of all divisors is less than twice the number, unless the deficiency is one.

Every perfect number is evidently a 'practical' number.

If $N$ is a 'practical' number, then $2N$ and therefore $2^t N$ is also 'practical'.

Further, the highly composite numbers of Ramanujan can be shown to be 'practical' numbers.

Three special types of 'practical' numbers are noticed :

(1) The $\alpha$-type :—$N_\alpha = 2^{\alpha_0} p_1^{\alpha_1} p_2^{\alpha_2} \ldots . p_n^{\alpha_n}$ where

$$2 < p_1 < p_2 < \ldots\ldots < p_n$$
$$2^{\alpha_0} < p_1 < 2^{\alpha_0+1},$$
$$\text{and } p_i^{\alpha_i} < p_{i+1} < p_i^{\alpha_i+1} \quad (1 \leqslant i \leqslant n-1).$$

In this type $\alpha_n$ is unrestricted. It includes even perfect numbers.

The product of the first $n$ primes also belongs to this type. *E.g.*: $2.3.5.7.11=2310$ is a 'practical' number.

The existence of the numbers of the $\alpha$—type is manifest from the well-known Bertrand's postulate.

(2) The $\beta$-type:—$N_\beta = 2^{\beta_0} p_1^{\beta_1} p_2^{\beta_2} \ldots\ldots p_n^{\beta_n}$

$$2 < p_1 < p_2 < \ldots\ldots < p_n,$$
$$p_1 < 2^{\beta_0+1},$$
$$\text{and } p_{i+1} < 2^{\beta_0+1} p_1^{\beta_1} p_2^{\beta_2} \ldots\ldots p_i^{\beta_i} \quad (1 \leqslant i \leqslant n-1).$$

Obviously, $2^{t_0} p_1^{t_1} \ldots p_n^{t_n}$ is also a "practical" number of the $\beta$—type when $t_i \geqslant \beta_i$ ($i=0, 1, 2, \ldots\ldots, n$).

This type is of wider scope than the α-type and includes it as a subclass. Ramanujan's highly composite numbers belong to the β-type but not to the α-type *E g.*: 36, 48; 180.

(3) The γ-type ;—$2^{\gamma_0}p_1 \; (2^{\gamma_0+1}p_1+1)$ where $2^{\gamma_0}p_1$ is a perfect number and $2^{\gamma_0+1}\; p_1+1$ a prime

*E.g.*: 2.3.13 = 78.

All 'practical' numbers less than 201 belong to one or other of the types given above as may be easily verified from the table given below:—

| | | | | | | |
|---|---|---|---|---|---|---|
| 2 | 20 | 42 | 72 | 100 | 132 | 168 |
| 4 | 24 | 48 | 78 | 104 | 140 | 176 |
| 6 | 28 | 54 | 80 | 108 | 144 | 180 |
| 8 | 30 | 56 | 84 | 112 | 150 | 192 |
| 12 | 32 | 60 | 88 | 120 | 156 | 196 |
| 16 | 36 | 64 | 90 | 126 | 160 | 198 |
| 18 | 40 | 66 | 96 | 128 | 162 | 200 |

The three types envisaged here do not exhaust probably all possible cases. The general structure is, *however, unknown. If the tables* are enlarged, up to at least 1000, we may meet with other types. Our table shows that about 25 per cent. of the first 200 natural numbers are 'practical'. It is a matter for investigation what percentage of the natural numbers will be 'practical' in the long run.

St. Philomena's College, Mysore, A. K. SRINIVASAN.
*February* 7, 1948.

## THE CANONICAL CO-ORDINATE SYSTEM IN GENERAL RELATIVITY

THE canonical co-ordinate system[1] for which, at the origin, all the first order partial derivatives of $g_{\mu\nu}$ vanish and the second order derivatives are given by a set of hundred equations is well known in the literature of general relativity. It is particularly useful for exploring the neighbourhood of an event in the space-time continuum. We have not seen anywhere the Taylor expansions of $g_{\mu\nu}$ defining the canonical co-ordinate system. The expansions contain explicitly the twenty independent components of the Riemann–Christoffel[2] tensor $R_{hijk}$. As the metric tensor defines not only the co-ordinate system but the gravitational field itself, we have found the expansions of special interest and service in discussing the purely geometrical, as well as gravitational properties of the relativity metric. A full report is being prepared for communication elsewhere. We have thought it worthwhile to place only the expansions here on record.

We define the twenty independent components of $R_{hijk}$ at (0, 0, 0, 0) by the following equations :

$$R_{1212}=a,\quad R_{1313}=b,\quad R_{1414}=c,$$
$$R_{2323}=d,\quad R_{2424}=e,\quad R_{3434}=f,$$
$$R_{2113}=g,\quad R_{2114}=h,\quad R_{3114}=i,$$
$$R_{1223}=j,\quad R_{1224}=k,\quad R_{3224}=l,$$
$$R_{1332}=m,\quad R_{1334}=n,\quad R_{2334}=o,$$
$$R_{1442}=p,\quad R_{1443}=q,\quad R_{2443}=r,$$
$$R_{1234}=s,\quad R_{1423}=t.$$

If the powers above the second of the coordinates of an event in the neighbourhood of the origin are ignored we have

$$g_{11}=-1\;\tfrac{1}{3}(ay^2+bz^2+c\tau^2-2gyz\;-2hy\tau-2iz\tau),$$
$$g_{22}=-1-\tfrac{1}{3}(ax^2+dz^2+e\tau^2-2jxz-2kx\tau-2lz\tau),$$
$$g_{33}=-1-\tfrac{1}{3}(bx^2+dy^2+f\tau^2-2mxy-2nx\tau-2oy\tau),$$
$$g_{44}=1-\tfrac{1}{3}(cx^2+ey^2+fz^2-2pxy-2qxy-2ryz)$$
$$g_{12}=\tfrac{1}{3}\{mz^2+p\tau^2+axy-gxz-hx\tau-jyz-ky\tau-(2t+s)\,z\tau\},$$
$$g_{13}=\tfrac{1}{3}\{jy^2+q\tau^2-gxy+bxz-ix\tau-myz-nz\tau+(t-s\}\,y\tau,$$
$$g_{14}=\tfrac{1}{3}\{ky^2+nz^2-hxy-ixz+cx\tau-py\tau-qz\tau+(t+2s\}yz,$$
$$g_{23}=\tfrac{1}{3}\{gx^2+r\tau^2-jxy-mxz+dyz-ly\tau-ozt+(t+2s)\,x\tau\},$$
$$g_{24}=\tfrac{1}{3}\{hx^2+oz^2-kxy-px\tau-lyz+ey\tau-rz\tau+(t-s)\,xz\},$$
$$g_{34}=\tfrac{1}{3}\{ix^2+ly^2-nxz-qx\tau-oyz-ry\tau+fz\tau-(2t+s)\,xy\}.$$

In the above $x, y, z, \tau$ stand for the usual $x^1, x^2, x^3, x^4$. The algebraic work involved in the above calculation is quite tedious, but the symmetry of the various terms at each stage provides a useful check on the details and simplifies the calculation.

Benares Hindu University, V. V. NARLIKAR.
*May* 28, 1948. AYODHYA PRASAD.

1. Eddington, A. S., *The Mathematical Theory of Relativity*, 1924, 79. 2. Eisenhart, L. P., *Riemannian Geometry*, 1926, 20.

## THE VANISHING OF RAMANUJAN'S FUNCTION τ (N)

MAKING use of certain congruence properties of Ramanujan's function $\tau(n)$ defined by the relation

$$\prod_{r=1}^{\infty}(1-x^r)^{24}=\sum_{n=1}^{\infty}\tau(n)\,x^{n-1},\;|\,x\,|<1,$$

Lehmer has recently shown that

$$\tau(n)\neq 0 \text{ for } n<3316799.$$

More recently Chowla and Bambah have proved that

(1) $\tau(n)\equiv\sigma_{11}(n)\pmod{256}$ if $n$ is odd ;

(2) $\tau(n)\equiv 5n^2\,\sigma_7(n)-4n\,\sigma_9(n)\pmod{125}$ if $(n, 5)=1$ ;

(3) $\tau(n)\equiv(n^2+k)\,\sigma_7(n)\pmod{81}$,
where $k=9$ if $n\equiv 2\pmod 3$
and $\phantom{k}=0$ otherwise.

In view of these results, it is now possible to state that

$$\tau(n)\neq 0 \text{ for } n<1791071999.$$

In fact, the only possible solutions of $\tau(n)=0$ below 23866079999 are $n=1791071999$ and 8955359999. Since $\tau(n)$ cannot vanish except when $n$ is a prime, it remains to be seen if any of these numbers is a prime. This has to be verified from a table of primes, which is not accessible to me at present.

Govt. College, Hoshiarpur, HANSRAJ GUPTA.
*June* 4, 1948.

1. Lehmer, D. H., *Duke Math. Jour.*, 1947, **14**, 429-33
2. Bambah, R. P., and Chowla, S., *Bull. American Math. Soc.*, 1947, **53**, 950-55.

## PIGEONITE IN CERTAIN DOLERITE DYKES NEAR ROBERTSONPET (KOLAR)

CERTAIN "abnormal" dolerite dykes (meta-dolerites) from the charnockitic areas in Mysore have been described by Mr. B. Rama Rao[1] Director of Geology, Mysore Geological Department and Mr. P. R. J. Naidu, Assistant Professor of Geology, University of Mysore. Naidu, while describing the pyroxenes of such dolerite dykes near Halagur and Dodkanya (two other charnockitic areas), calls them "Pigeonite"[2]. So far, this mineral has been reported to occur in Mysore in certain "abnormal" dolerite dykes which are associated with charnockites. But in this paper is set forth a detailed description of the optical characters of pigeonite which has been for the first time noticed to occur in certain dolerite dykes near Robertsonpet (Kolar), which are not at all associated with charnockites.

These dykes cut across the general foliation of the Champion gneiss and the ferruginous quartzites with a rough east-westerly trend. Microsections of specimens of the dykes show plagioclase laths and pyroxene plates disposed in a sub-ophitic texture. Most of the felspars are plagioclase showing zoning and multiple twinning. There are occasional crystals of microcline and orthoclase.

Some of the pyroxenes are colourless while others are pinkish showing pleochroism. Many of them have reaction rims of green to bluish green hornblende. The blue tufts in the reaction rims pass sometimes into scales of reddish brown biotite. There are also intergrowths of augite and magnetite. Generally the diopside (colourless pyroxene) showing $Z \wedge C = 36°$ to 43° is intergranular but where the diopside is absent its place is taken up by altered minerals like chlorite or amphibole.

The pyroxene showing the pleochroism is *pigeonite*. It occurs as tabular prismatic crystals with an euhedral or subhedral outline. It shows positive elongation and positive optic sign, giving $Z \wedge C = 30°$ to 43°. The pleochroism exhibited by this mineral is as follows:–

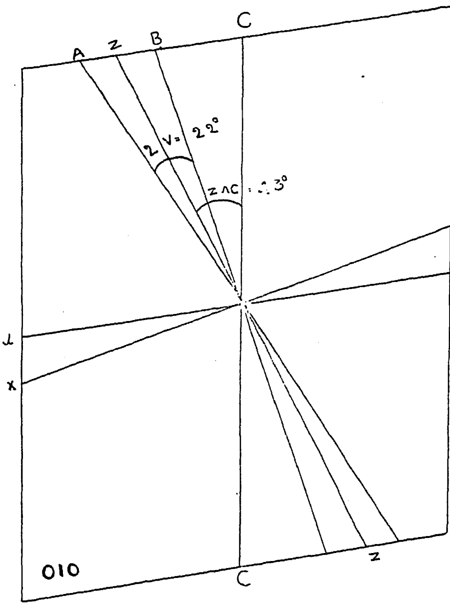
X = pink
Y = brownish pink.
Z = pale green.

Refractive Indices:—

$\alpha = 1.700$
$\beta = 1.705$
$\gamma = 1.725$
$(\gamma - \alpha) = 0.025$ (Berek's compensator)

It shows a small optic axial angle varying from almost uniaxial type where $2V = 0$ to larger angles, generally 18° to 22°. The dispersion noticed is of the inclined type where $r > v$ and hence the optic plane is parallel to (010). The parallelism of the optic axial plane to (010) indicates that this pigeonite is a calcic variety with about 7 to 10% of Cao.[3]

Wahl pointed out the general occurence of pigeonite in basaltic rocks many years ago and Fermor concluded that pigeonite was the most abundant pyroxene in nature[4]. In 1900, Winchell examined the pyroxene of the olivine diabase of Pigeon Point, Minnesota. He found that this mineral showed abnormal optical properties. He concluded that the "abnormal" optical properties of the mineral can scarcely be attributed to the chemical composition".[5] In 1906, Lacroix designated it clinoenstatite or clinohypersthene[6], but later he adopted




$2V = 18° - 22°$, + ve
$\gamma - \alpha = 0{\cdot}025$
$Z \wedge C = 30°$ to 43° XZ ∥ 010
Positive Elongation
X = Pink
Y = Brownish Pink
Z = Pale Green

Winchell's pigeonite[7]. It was re-defined by H. H. Hess of the Princeton University, New Jersey, in terms of composition, as a variety of pyroxene with a calcium silicate content of $W_o$ varying between $Wo_5$ & $Wo_{15}$ ($2V = 0$ to a maximum of $< 32°$, augite and ferroaugite $2V > 32°$).[8]

Pigeonite from the granulites of the charnockite series has been described by Dr. Groves[9]. According to him, the pigeonites of Uganda are rich in clinoenstatite or clinohypersthene molecules and are classified under the diopside-hedenbergite series. Pigeonites from the "abnormal" dolerite dykes near Halagur and Dodkanya have been described by Mr. P.R. J. Naidu. He assigns them to the enstatite-diopside series.[10]

In the case of mixtures of the minerals of the two series (enstatite-diopside series or diopside-hedenbergite series), a formula of Mallard quoted by Wahl[11] shows that the extinction angles of mixed pyroxenes would be nearer to the members of higher extinction angles and higher birefringence. The pigeonite, described in this paper, shows extinction angles ranging from 30° to 43°, and birefringence, 0·025, that is, figures approaching the extinction angles and the birefringence of the hedenbergite end of the diopside-hedenbergite series. Hence this pigeonite is assigned to the diopside-hedenber-

gite series. Computed from Winchell's Variation diagrams[12], it has a composition, $5CaMgSi_2O_6 . 6CaFeSi_2O_6$. Therefore this pigeonite differs from the pigeonite of charnockitic areas in Mysore in belonging to the diopside-hedenbergite series.

M. G. CHAKRAPANI NAIDU.
K. C. CHANNABASAPPA.

Department of Geology,
Central College,
Bangalore,
*June* 15, 1948.

1. *Records M. G. D.*, 1940, **39**, 51. 2. *Curr. Sci.*, **12**, 4. 114–115. 3. A. N. Winchell, *Elements of Optical Mineralogy*, 1933, **2**, 222. 4. *Records G. S. I.*, 1925. **58**, 323. 5. *American Mineralogist*, 1900, **26**, 203. 6. *Bull. Soci. Nat. Onest.*, 1906, **6**, 81. 7. *Mineral France*, 1910, 767. 8. *American Mineralogist*, **26**, 517–518. 9. *Q. J. G. S.*, **91**, 155. 10. *Curr Sci.*, **12**, 4. 115. 11. Tschermak's Min. U. Pet. Mittherl., *New Series*, 1907, **26**, 116. 12. A. N. Winchell., *Elements of Optical Mineralogy*, 1933 **2**, 226.

## BAND SPECTRUM OF THALLIUM IODIDE

IN a previous letter,[1] it is reported that bands of Thallium Iodide have been photographed in two regions: (1) from λ 5300 to λ 3750 and (2) from λ 3680 to λ 3600; the first presenting extensive groups mostly of red degraded bands and the second consisting of a few sequences of a brief system of violet degraded bands. Further work on these bands has shown that the first group of bands, interpreted previously as forming two overlapping systems, could be arranged into a single system corresponding to the transition $3_1 \rightarrow {}^1\Sigma^+$ with the (0,0) band at 25780·0 cm.$^{-1}$ and having the vibrational constants $\omega_e' = 94$ cm.$^{-1}$, $\omega_e'' = 122$ cm.$^{-1}$ and $\chi_e''\omega_e''$ having a small value, as observed previously. The analysis of the second brief system has led to the constants $\omega_e' = 150$ cm.$^{-1}$ and $\omega_e'' = 122$ cm.$^{-1}$ Considering this system as due to the transition ${}^3O^+ \rightarrow {}^1\Sigma^+$, the wave-number interval between the (0,0) bands of the two systems is found to be 1321 cm.$^{-1}$, which is in keeping with the corresponding intervals of the other similar halide molecules. A complete discussion will be published elsewhere.

Andhra University,
Waltair,
*April* 30, 1948.

P. TIRUVENGANNA RAO.
K. R. RAO.

1. *Curr. Sc.*, 1948, **17**, 121.

## ON SOME PHYSICO-CHEMICAL EVIDENCE OF THE DIVALENCY OF SILVER

THE following physico-chemical evidence supports the theory of divalency of silver.

Values for certain physical constants of silver, calculated on the basis of the divalency of the metal, are in good agreement with observed values for (*a*) vibration frequencies of atoms, (*b*) entropy, (*c*) distance of the closest approach of atoms and (*d*) velocity of sound.

The formulæ proposed by the author and employed in calculating the physical constants are as follows:—

1. $v = \sqrt{K}.v\frac{1}{2\pi}\sqrt{\frac{P-V}{V}\cdot\frac{Ze^2}{r^3}\cdot\frac{N}{M}}$, for vibration frequencies of atoms;[1]

2. $S_T = 3/2\,R\,ln\,\frac{M}{\left(K\cdot\frac{P-V}{V}\cdot\frac{Ze^2}{r^3}\right)} + 3\,R ln\,T + 2/3\left(Cp^2\frac{T}{T_s}+A_0\right)+C$, for entropies of metallic elements[2];

3. $D = f_1 \times f_2\ (v)\ \frac{P}{V_i \times d^{K_1}}$, for distance of the closest approach of atoms;[3]

4. $S = L\ \left\{\left(\frac{1}{2\pi}\cdot\sqrt{K}\sqrt{\frac{P-V}{V}\cdot\frac{Ze^2}{r^3}\cdot\frac{N}{M}}\right) \times \left\{f_1 \times f_2\ (v)\ \frac{P}{V_i \times d^{K_1}}\right\}\right.$, for the velocity of sound in metallic elements.[3]

In the above formulæ, P is parachor ($P_{Ag}=63$); V, atomic volume ($V_{Ag}=10.3$); Z, valency; *e*, elementary charge; *r*, atomic radius ($r_{Ag}=1.77$);[4] M, atomic weight; T, temperature (298.1); $T_s$, temperature of fusion; $V_i$, ionisation potential ($Vi_{Ag}=7.54$); *d*, atomic diameter; N, Avogadro's constant: $\sqrt{K}$, a constant with value $0.415\times10^{12}$; K, $0.1722\times10^{24}$; $A_0$, 0 214; C, 96.5; R, 8.32; $f_1\times f_2$ (v), 0.615 for monovalent elements, 1.166 for bivalent elements, 1.05 for trivalent elements; $K_1$, 0.925; L, 2.54.

These formulæ, it should be noted, gave values in comparative agreement with the experimental ones for these physical constants in an appreciable number of cases.

The following table gives values of the above physical constants for silver, calculated on the basis of the divalency of the metal. The corresponding values, calculated on the basis that silver is monovalent are also given for comparison.

| Physical Constants | Calculated values; Silver, Divalent | Calculated values; Silver, Monovalent | Values observed (and reference to authors) |
|---|---|---|---|
| Atomic frequency | $3.21\times10^{12}$ | $2.27\times10^{12}$ | $4.5\times10^{12}$ (5) |
| Entropy .. | 50·08 | 56·8 | 42·7[6] |
| Distance of closest approach of atoms | 3·026 | 1·596 | 2·876[7] |
| Velocity of sound | 2467 | 920 | 2645[8] |

It would be observed from the above table that the values of the physical constants for silver, calculated on the basis of its divalency,

are in better agreement with the observed values.

Chemical Laboratory, BINAYENDRA NATH SEN.
Burdwan Raj College,
Burdwan,
*January* 14, 1948.

1. Sen, B. N., *J. Indian Chem. Soc.*, 1934 **11**, 243. 2. —, *Chem. Phys.*, 1935, **32**, 300. 3. —, *Gazetta*, 1938, **10**, 68, 656-662. 4. Bragg, *Phil. Mag.*, 1920, **6**, 40, 169. 5. Nernst and Lindemann, *Z. Electrochem.*, 1911, **17**, 822. 6. "International Critical Tables," Vol V, 87. 7. Bragg, *X-Rays* and Crystal Structure, p. 163. 8. "International Critical Tables," Vol. VI, 465.

## STUDIES ON THE SUITABILITY OF SUGARCANE JUICE FOR THE GROWTH AND DISTRIBUTION OF SOME INTESTINAL PATHOGENIC BACTERIA

THE increase in the incidence of some intestinal infections during the warmer months in Bombay and the heavy sale of iced sugarcane juice as a drink suggested the possibility of the spread of some of the intestinal pathogenic bacteria through this source. The incidence of typhoid, paratyphoid, dysentery and cholera infections usually after the conclusion of certain religious fairs, *e.g.*, Pandharpur and Nasik, where large quantities of juice are consumed by pilgrims indicates this possibility. The suitability of this drink as a vehicle for the transmission of these infections, and as a medium for the growth and viability of *E. typhosa*, *S. paratyphi*, *S. schottmuelleri*, *S. dysenteriœ* (Shiga), *S. paradysenteriœ* (Flexner), *E. coli communis* and *V. cholerœ* has been studied.

The following is the average composition: Moisture 75·14%; total sugars (including the 1·16% of the fermentable monosaccharide) 13·60%; total proteins 0·24%; the other constituents which make up the remaining are pectins, lignins, crude cellulose, amides, aminoacids, gums and minerals. The PH of the juice varies from 6·8-7·0.

The microbiological examination of the juice revealed that the normal flora consists of Gram positive sporulating aerobic bacilli, *B. cohaerens*, *B. rufscens* and a starch hydrolysing variant of *B. mesentericus*, *Micrococcus perflavus* and an unidentified *Saccharomyces*. The essentially Gram positive character of the above flora enabled us to study conveniently the fate of the different Gram negative test organisms even in the non-sterilized samples of the juice.

A number of preliminary studies with the undiluted, 50% diluted, unfiltered, muslin-filtered, steam-sterilized and filter-sterilized samples were made: during these studies, methods essential for determining viability, multiplication, virulence and pathogenicity were also standardized. Sugarcane juice for the experimental studies was used in six different dilutions, *viz.*, 1:32 (3⅛% solution), 1:16 (6¼%), 1:8 (12½%), 1:4 (25%), 1:2 (50% solution), and in the undiluted state. These dilutions were used in their non-sterile, filter-sterilized and also steam-sterilized states. These various samples were then seeded in test-tubes with 0·1 ml. saline suspensions (matching Opacity Tube No. 4) of 24-hour growths of the selected bacterial species and incubated at the room temperature (28° C.) after 0·1 ml. portion from each tube was removed for the quantitative estimations of the inoculated bacteria. Further 0·1 ml. portions removed from each tube at regular intervals of time were utilized for counting the bacteria by the methods worked out for the purpose[1] in this laboratory. Special media such as the MacConkey's agar, Wilson and Blair agar, Leifson's desoxycholate citrate agar and Aronson's agar, were utilized for the quantitative studies, and peptone water, nutrient broth and MacConkey's broth, for testing viability. The morphological, staining, biochemical and antigenic variations occurring in the bacteria were also followed by adopting suitable techniques. The results obtained indicate that multiplication and maximal survival periods for these bacteria vary not only from species to species, but also with regard to the dilution effected, the sterility status of the juice and other factors. It should be mentioned here, however, that the presence of *E. typhosa* and *S. schottmuelleri* in cane juice must be regarded as potentially dangerous in view of the fact that these bacteria are more tolerant to the juice (particularly the unheated samples) and that they not only show a multiplication stage but continue to live in this substratum for a few days without any appreciable loss in their general characteristics. Shiga and the Flexner dysentery strains, on the other hand, do not find the juice very favourable for growth; observations with *E. coli* show that his organism can and does remain potent in the juice and as such its presence in large numbers in the juice must be regarded, as we do in water analysis, as an index of contamination through fæces, soil, flies, finger, ice or other sources. For the cholera vibrios the cane juice, despite its fermentable saccharose contents, is a poor medium and consequently the danger of cholera infections through this channel is very remote.

Details of these investigations will be sent for publication elsewhere. In the meantime, it is pertinent to mention here that thus far three cases of infection (one of typhoid and two of food-poisoning) have been brought to our attention and all these cases had their suspected origin to this drink. Unfortunately, these cases came in too late for bacteriological confirmation.

Microbiology Dept.
St. Xavier's College, J. V. BHAT.
Bombay, RODA N. REPORTER.
*January* 28, 1948.

1. Reporter, R. N., "Suitability of certain foods and drinks for the growth and distribution of some intestinal pathogenic bacteria," *M.Sc.*, Thesis, Bombay Univ., 1944.

## AN INSECT TUMOUR AND OVARIAL HORMONE

SULC[1] was the first to discover a rectal tumour in Fulgorid insects. Buchner[2] confirmed this, adding that "the most remarkable fact about this organ is that it is always found in the female, a circumstance which escaped Sulc." While at Brünn, in Czechoslovakia, I found *Fulgora europœa* easily available. For over two months, about ten female insects were dissected daily, as a routine, but only once did I come across a specimen where the rectal tumour was absent. When its ovary was examined it was so atrophied as to be considered absent; the genital armature had to be examined to be sure of the sex identity. The above finding established clearly the simultaneous absence of a normal ovary and that of the rectal tumour which thus confirms Buchner's observations and explains the influence of the ovarial hormone on the growth of the rectal tumour.

The brief mention that the rectal tumour was absent would naturally convey the notion that the germ or symbiote, found in the rectal tumour, was altogether wanting from the insect body. From the writings of Sulc it is by no means clear whether each tumour has its special micro-organism. In *Tettigometra obliqua* he finds many tumours but only of three types. One, which he calls the clump-forming tumour, is divided into four units, but represents morphologically the same structure. Thus, according to Sulc, there would be only three symbiotes, one for each type of tumour. In fact, he has illustrated the three germs as morphologically different, in Figs. 51, 53 and 54. In the case of *Fulgora europœa* he has, unfortunately, not given illustrations of the germs in symbiosis with it. He has however done this with *Oliarus cuspidatus*, where Fig. 6 represents the germ found in the rectal tumour and Fig. 9 that in the clump forming tumour. Now Buchner[2] has subsequently shown that, in *F. europœa*, the germ in the rectal tumour is identical with that found in, what Sulc calls, the clump-forming tumour. I have confirmed this observation by isolation. The germ of *F. europœa* is a pigment producer, identical with the yellow colour found within the body of the insect. That of *O. cuspidatus* produces a red pigment, probably $\beta$-carotene. What is interesting is that these germs produce zoogloeal colonies which unwittingly induced Sulc to give the appropriate term, clump-forming tumour. The absence of rectal tumour thus does not mean the absence of the symbiote, for it is always present in the clump-forming tumour. The formation of the rectal tumour is thus not so much a microbiological phenomenon as a physiological one, being more intimately connected with the function of the female sex hormone.

Now all homopterous insects have tumours on either side of the abodomen. It is equally well known that they are better developed in the female, which thus indicates the share of the female sex hormone. There are germs that directly induce cell multiplication. Mary,[3] in the chapter on the Colloid Chemistry of Tuberculosis, writes that "when we speak of tuberculosis tissue it is not a question of an altered normal tissue. A neoplastic formation is in reality involved for whose formation no bacillus is essential, the agent being always of a toxic nature... (Tissue culture experiments indicate) histological changes of tuberculosis (with) figures showing mitosis." Like the germ of tuberculosis, that of leprosy, also induces new cellular growth. Symbiotic germs of insect tumours probably do the same. That of *Cicadella viridis*,[4] already isolated, secretes phosphatases which would go to attribute such a property. However, in insects with rectal tumours the new growth is the combined result of bacteria and that of the female sex hormone, where the latter is the leading factor.

S. MAHDIHASSAN.

Biochemical Laboratory,
Cipla Ltd.,
Bombay,
*April* 26, 1948.

1. *Pub. biol. Ecoles Haut Etudes veter. Brunn.*, 1924, **3.** 2 *Zeit. f. Morph. u. Okolog.*, 1925, **4,** 3. *Alexander, Colloid Chemistry*, **2,** 872–5. 4. *Curr. Sci.*, 1947, **16,** 58.

## 2-THIOL-4:5-DIPHENYLIMIDAZOLE DERIVATIVES

CORRELATING the chemical structure and sympathomimetic activity, Barger and Dale[1] enunciated the "$\beta$-phenylethylamine rule" which states that "the optimum constitution of fatty aromatic amine for the production of sympathomimetic action is, ....that which is found in adrenaline itself, *viz.*, a benzene ring and a side chain of two carbon atoms of which the second bears the aminogroup". Imidazole derivatives[2] have recently come to the forefront as possible sympathomimetics, the 2-$\alpha$ naphthylmethylimidazoline (Privine) having already been introduced into medicine. Further, S-methylisothiourea sulphate[3] has been reported to overcome fall of blood pressure in spinal anæsthesia.

With a view to studying the pressor activity of compounds possessing all the structural characteristics detailed above, a number of 2-thiol-4:5-diphenylimidazole derivatives (*vide* table) of the type (I) have now been synthesized. Müller[4] prepared N-aryl derivatives of 2-thiol-4:5-diphenylimidazole by heating benzoin with N-substituted thioureas and alcohol, in sealed tube at about 180-90° C. for 4-5 hrs. Biltz and Krebs[5] prepared 2-mercapto-4, 5-diphenylimidazole by fusing benzoin and thiourea in the absence of any solvent. Extending the latter method to N-substituted thioureas, compounds 12, 13, 16 and 19 (*vide* table) have been prepared by fusing benzoin with the appropriate thiourea at about 200° C. and purifying the products directly by crystallisation after removing the reactants, or through their alkali salts.

By the action of the corresponding halogen compounds in alcoholic solution on the appropriate 2-thiol, 4, 5-diphenylimidazole, the thioethers Nos. 1 to 11, 14, 15, 17 and 18 (*vide*

TABLE

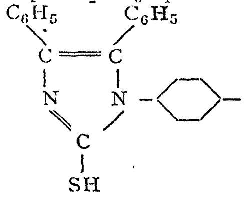
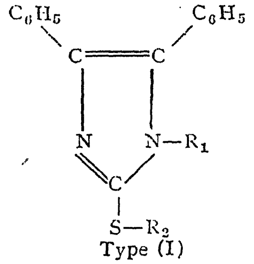
| No. | $R_1$ | $R_2$ | M.P.° C. |
|---|---|---|---|
| 1 | H | $-CH_2-CH_2-CH_3$ | 174 |
| 2 | H | $-CH_2-CH=CH_2$ | 181–2 |
| 3 | H | $-CH_2-CO-CH_3$ | 150–1 |
| 4 | H | $-CH_2-CH_2-OH$ | 167 |
| 5 | H | $-CH_2-COOH$ | 216 |
| 6 | H | $-CH_2-C_6H_5$ | 185–6° |
| 7 | H | $-C_6H_4-NO_2-p$ | 209 |
| 8 | H | $-C_6H_2-(NO_2)_3$ 2, 4, 6 | 186 (decomp.) |
| 9 | $C_6H_5$ | $-CH_2-CO-CH_3$ | 153–4 |
| 10 | $C_6H_5$ | $-C_6H_3(NO_2)_2$ 2, 4 | 199–200 |
| 11 | $C_6H_5$ | $-C_6H_2(NO_2)_3$ 2, 4, 6 | 205–6 (decomp.) |
| 12 | o $CH_3-C_6H_4$ | H | 288–9 (decomp.) |
| 13 | p $CH_3-C_6H_4$ | H | 319–20 (decomp.) |
| 14 | p $CH_3-C_6H_4$ | $-C_6H_3(NO_2)_2$ 2, 4 | 233 |
| 15 | p $CH_3-C_6H_4$ | $-CH_2-C_6H_5$ | 191 |
| 16 | p $CH_3O\ C_6H_4$ | H | 297 (decomp.) |
| 17 | p $CH_3O\ C_6H_4$ | $-CH_2-C_6H_5$ | 191–2 |
| 18 | p $CH_3O\ C_6H_4$ | $-C_6H_2-(NO_2)_3$ 2, 4, 6 | 168 (decomp.) |
| 19 | p $NO_2-C_6H_4$ | H | 284 (decomp.) |
| 20 |  | | does not melt even at 340 |

table) have been prepared. Two molecules of benzoin reacted with p-phenylene bisthiourea to give compound 20.



Type (I)

Full details will be published elsewhere.

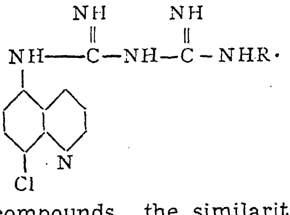
Organic Chemistry Laboratories, Indian Institute of Science, Bangalore, April 1, 1948.

M. V. BHATT.
B. H. IYER.
P. C. GUHA.

1. Barger and Dale: *J. Physiol*, 1909, **41**, 19.
2. Scholz, *J. Ind. and Engg Chem.*, 1945, **37**, 120-5.
3. Smirk and McGeorge, *Lancet*. 1912, **243**, 301.
4. Müller, *Annalen*, 1894, **284**, 25–35.
5. Biltz and Krebs, *ibid.*, 1912, **391**, 194–95.

## STUDIES IN ANTIMALARIALS SOME N¹-(8-CHLORO-5-QUINOLYL)-N⁵-SUBSTITUTED BIGUANIDES

IN continuation of our work on quinoline substituted biguanides as possible antimalarials,[1] a number of N¹-(8-chloro-5-quinolyl)-N⁵-substituted biguanides of type (I) have now been synthesised. May, *et al*[2] have prepared a few methoxy-8-quinolyl biguanides but found them inactive against blood inoculated *P. gallinaceum* infection. In the present



type (I)

series of compounds, the similarity to paludrine[3] is kept up in that the biguanide chain is at 5-position and the chlorine atom at the 8-position of the quinoline nucleus. It may also be interpreted that a pyridine ring is fused to the *p*-chlorobenzene nucleus, present in paludrine and it is hoped that they will be active against malaria parasites.

The compounds (*vide* Table I), were prepared by condensing 8-chloro-5-amino-quinoline hydrochloride with the appropriate cyanoguanidines in alcoholic solution. The base was liberated from the reaction mixture by treating it with dilute alkali solution and purified by recrystallising from organic solvents. The acetates prepared in the usual manner, were purified by recrystallisation from absolute alcohol and dry acetone.

While both the base and the salt (No. 1 in Table I) from the reaction with cyanoguanidine contain one molecule of water of crystallisa-

tion, none of the other bases or salts contain any water of crystallisation.

| No. | R | m.p. of base | m.p. of salt |
|---|---|---|---|
| 1 | $-H, H_2O$ | 213° C. (d) | 229–30° C. (d) |
| 2 | $C_6H_5-$, | 198 (d) | 188-189 (d) |
| 3 | p-$CH_3-C_6H_4-$, | 170–171 (d) | 288 (d) |
| 4 | p-$CH_3O-C_6H_4-$, | 210–11 (d) | 182–183 (d) |
| 5 | p-$CH_3CONHC_6H_4-$. | 194–96 (d) | 242–43 (d) |
| 6 | p-$NH_2-C_6H_4-$, | 165–66° C. (d) | 228–30° C. (d) |
| 7 | p-$NO_2-C_6H_4-$, | 207 (d) | 214–15 (d) |
| 8 | p-$Cl-C_6H_4-$, | 214 (d) | 143–44 (d) |
| 9 | p-$Br-C_6H_4-$, | 210–11 (d) | 160–62 (d) |
| 10 | p-$I-C_6H_4-$. | 152° C. | 269–70° C. (d) |

Full details will be published elsewhere.

Our sincere thanks are due to Dr. B. H. Iyer for his ungrudging help and to the Lady Tata Memorial Trust for the award of a research scholarship to one of us (P. R. Gupta).

P. R. GUPTA.
P. C. GUHA.

Organic Chemistry Laboratories,
Dept. of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore,
*April* 19, 1948.

1. Gupta, P. R., Iyer, B. H., Guha, P. C., *Current Science*, 1948, **17**, 53. 2. May, E. L., *et al*, *J. Org. Chem.*, 1947, **12**, 869. 3. Curd, F. H. S., *et al*, *J. C. S.*, **1946**, 729.

## ARYLCYANOGUANIDINES FROM ARYLAZOCYANOGUANIDINES

WALTHER and Grieshmmer[1] converted the arylazocyanoguanidines referred to as triazene) into their labile hydrochloride salts which on treatment with hot water liberated the azo-nitrogen to give arylcyanoguanidines. It has been possible to denitrogenate the above type of triazenes in a mixture of a hydrolytic solvent and acid at low temperature to get the required products.[1,2,3] Consequently a systematic study of p-chloro-phenylazocyanoguanidine has been made in various mixtures of hydrolytic solvents and acids and it has been observed that a mixture of acetone, acetic acid or dioxane with hydrochloric acid or sulphuric acid at 30-40° C. gives best yields of p-chlorophenylcyanoguanidine (an important intermediate for the synthesis of paludrine). Only a few arylcyanoguanidines have been prepared.[1], The following new substituted arylcyanoguanidines have been prepared by this method which have been used as intermediates for the synthesis of substituted biguanide as potential antimalarials :—

2 : 4-Dichlorophenylcyanoguanidine (217° C. m.p.); o-Chlorophenylcyanoguanidine (170°); *meta*-chlorophenylcyanoguanidine (232-33°); *m*-bromophenylcyanoguanidine (233°); p-iodophenylcyanoguanidine (217°); p-fluorophenylcyanoguanidine (211°); o-methylphenylcyanoguanidine (205°); *m*-methylphenylcyanoguaneidine (202°); *p*-cyanophenylcyanoguanidin; (244°); *m*-nitrophenylcyanoguanidine (229°) and $\beta$-naphthylcyanoguanidine (237°).

Attempts to prepare $N^4$-cyanoguanidino sulphanilamides from the corresponding triazenes have failed due to the non-formation of labile hydrochlorides of these triazenes which are perhaps necessary for such a denitrogenation[1]. This was due to the acidic nature of the substituents in the phenyl ring which hindered the formation of such a intermediate labile salt. It has also not been possible to obtain similar triazenes derived from trihalogen substituted anilines and 2-aminothiazole, while both the diazonium groups derived from benzidine have reacted only with one molecule of cyanoguanidine.

Full details of this work will be published elsewhere.

Thanks are due to Professor P. C. Guha and Dr. B. H. Iyer, for their guidance and kind interest and to the Indian Research Fund Association for the award of a fellowship.

H. L. BAMI.

Organic Chemistry Laboratories,
Indian Institute of Science,
Bangalore,
*May* 3, 1948.

1. Walther and Grieshmmer, *J. fur Prakt. Chem.*, 1915, **92**, 209. 2. Bami, Iyer and Guha, *J. Indian Inst. Sci.*, 1946, **29A**, 1, 15. 3. Broadbent and Rose, U. S. Patent 2409832, 1946.

## TAMARIND AND CHILLIES—THEIR EFFECT ON S. INDIAN DIET

THE work of Krishnamurti, De and Subramanyan[1] on the above subject is extremely interesting. But, it is in apparent variance with the work of earlier nutrition schools. Chillies and Tamarind are good sources of vitamin C. It is well known that such natural sources of vitamin C usually contain vitamin P (also called Citrin or $C_2$). The work of Cotereau and others[2] shows that vitamin P plays a very important role in the absorption and retention of vitamin C. Chillies and red pepper are good sources of vitamin P just like cabbages, citrus fruits, buck-wheat and lemon peel. Chillies form a daily article of diet in the food of the South Indians and of most other Asiatics. In spite of an apparently poor diet, the population of S. India cannot be definitely said to be of lower vitality. This anomaly is due probably to the intake of vitamin P in the chillies and tamarind. The idea is being pursued.

Medical College,
Poona,
M. N. NARAYANA.
*May* 10, 1948.

1. Krishnamurti, *et al.*, *Curr. Sci.*, 1948, **17**, 51.
2. Cotereau, *et al.*, *Nature*, 1946, **158**, 343; *Ibid.*, 1948, **161**, 557.

## NOTE ON THE RECOVERY OF OIL FROM SEED CAKES OF OIL EXPELLERS

NARASINGA RAO AND SUBBAIAH,[1] have enriched the sugar factory press-cake with respect to its wax content, by a simple froth flotation process. Similar experiments were conducted with an oil-cake containing 12·3% oil. The material is ground up with water, and the slurry is froth floated in a small Callow s cell.

| Expt. No. | Conditions | Froth | | Gangue | |
|---|---|---|---|---|---|
| | | Wt. % Cake | Oil % | Wt. % Cake | Oil % |
| 1 | 10% slurry + ·5 c.c. pine oil per litre | 32 | 22·5 | 68 | 7·5 |
| 2 | 15% slurry + ·5 c.c. pine oil per litre | 27 | 20·2 | 73 | 9·3 |
| 3 | 10% slurry alone | 21 | 21·1 | 77 | 9·9 |

The emulsion was extracted with petroleum ether for estimating the oil. The separation of the emulsion was also attempted in laboratory Sharple's super-centrifuge with promising results. A study of the factors which control this separation is now in progress.

Thanks are due to Dr. M. Narasinga Rao, Technology Laboratories, Andhra University, Waltair, for suggesting the problem and for guidance.

Chemistry Department,
Mrs. A. V. N. College,
Vizagapatam,
June 5, 1948.

K. SATYANANDA RAO.
R. SUBBAIAH.

1. *J. Sci. Ind. Res.*, 1947, **68**, 178.

## A NOTE ON "THE FORMATION OF COMPLEX COMPOUNDS BETWEEN LEAD NITRATE AND ALKALI NITRATES"

ACCORDING to Ephraim,[1] "Nitrates do not easily form complex compounds in which several $NO_3$ groups co-ordinate with a metal atom. The number of easily dissociated nitrato salts, the so-called double nitrates, is not comparable with that of double halides or sulphates. Almost the only metals which can act as central atoms in double nitrates are those with high atomic weights, in particular Ba, Hg, Au, Tl, Pb, Th and Bi. The formula of potassium barium nitrate, $K_2[Ba(NO_3)_4]$, serves as an example of the constitution of these compounds".

When aqueous solutions are prepared in such a way that the concentration of alkali nitrate is kept constant while that of lead nitrate is systematically varied and the physico-chemical properties of the solutions are measured and plotted with respect to the concentration of $Pb(NO_3)_2$, regular curves are obtained in some cases, while abnormalities with specific maxima are observed in others. There is excellent similarity in the curves with respect to all the physico-chemical properties, so that there is no question about the genuineness of the phenomenon. Maxima occur at exact stoichiometric ratios of concentrations corresponding to the compounds :— $4\,RNO_3.Pb(NO_3)_2$, $2\,RNO_3.Pb(NO_3)_2$ and $RNO_3.Pb(NO_3)_2$ (where R = K, $NH_4$ or Rb). No abnormalities, however, are observed in the case of $LiNO_3$ (or $NaNO_3$)-$Pb(NO_3)_2$-$H_2O$ systems.

When attempts are made to prepare these compounds from solution by evaporation or cooling, the constituents separate out indicating that these compounds are stable only in solution. The physico-chemical properties employed for their detection were : viscosity, rheochor, parachor, conductivity, freezing point, E.M.F., magnetic susceptibility, pH and transport number. The compounds are produced in solution presumably according to the equation :

$$x\,KNO_3 + Pb(NO_3)_2 \rightleftharpoons K_x\,[Pb(NO_3)2+x]$$

(where $x$ = 1, 2 or 4). That such a reaction does take place is convincingly indicated by experiments on transport number, where the cationic Pb is seen to be converted to anionic Pb. Therefore in solution the equilibrium shown above shifts to the right, while on crystallisation there is rapid reversal, so that crystals consist of either $KNO_3$ or $Pb(NO_3)_2$ or a mixture of the two.

The fluoberyllates and chloroberyllates reported by Purkayastha[2] probably behave similarly.

Full details of our work on the complex nitrates of lead appear in the *Proceedings of the Indian Academy of Sciences*[3]

The Department of Chemistry,
Lucknow University,
Lucknow,
June 8, 1948.

M. R. NAYAR.
C. S. PANDE.

1. Fritz Ephraim, *Inorganic Chemistry*, 4th edition, 1943, 699. 2. *J. Indian C.S.*, 1943, **25**, 81; 1947, **24**, 257. 3. *Proc. Indian Acad. Sci.*, April 1948 and subsequent issus.

## PROTHALLUS OF *LYCOPODIUM HAMILTONII* SPRING

IN 1938, while describing the species of *Lycopodium* in the Bombay Presidency, the rare occurrence of an epiphytic species, *L. Hamiltonii* was noted by me.[1] The material on which this observation was based came from Ainsi, a village in the forests of North Kanara District. Subsequently lot of material of the same species came to my hands through the kindness of Professor H. G. Champion and Dr. S. P. Agharkar who had collected it at Lohjang, Kailganga Valley in the Garhwal Himalayas and at Mawphalong in Assam respectively. A comparison of this material with the one I had from the Bombay Presidency clearly showed that under the name *L. Hamiltonii* several species have been lumped together, which now have been rightly separated into *L. Hamiltonii* proper, *L. aloifolia*, *L. petiolatum*, *L. obtusifolium* by Chowdhury.[2]

On a recent collecting trip to Lonawala during last August, some specimens of this species proper were noticed on the tree trunks of *Holigarna Grahamii*, *Mangifera indica*, etc., at

a height of about 30-40 feet on fully grown trees thriving luxuriantly in a cool and shady grove. Curiously enough, the plants though epiphytic were not pendulous as in *L. Phlegmaria* and other epiphytic species but were erect or suberect. Their bases were enveloped in rich humus and blue green algæ growing together with some grasses, orchids such as *Eria Dalzelii*, *Eria crispa*, and ferns such as *Nephrolepis paucifrondosa*, *Leucostegia oulchra*, etc. Within this particular locality the lycopod was fairly common on the tree trunks and older branches at great heights, but outside the locality it was not noticeable at all. This suggests that like *Psilotum triquetrum* Sw. growing not very far from this locality[3] this lycopod also is both local and rare. The fully formed plants were about a foot long, occasionally epiphytic.[4] The vegetative propagation by means of bulbils seems to be the main mode of propagation in this lycopod as in several other species. It thrives in the monsoons and forms spores from about August to October. The older branches gradually die out but the young ones survive and the plant is able to parennate thereby.[5]

The species belongs to the subgenus "*Urostachya*" and to the group "*Selago*" in which the axillary sporangia are not clustered into a cone, but rather alternate with the vegetative parts on the plant (Fig. 2). The spores are finely tuberculated, the tubercles being mainly present on the lower hemispherical face, sometimes fusing into irregular thickening (Fig. 4).

Repeated attempts were made to find the prothalli on subsequent occasions and resulted

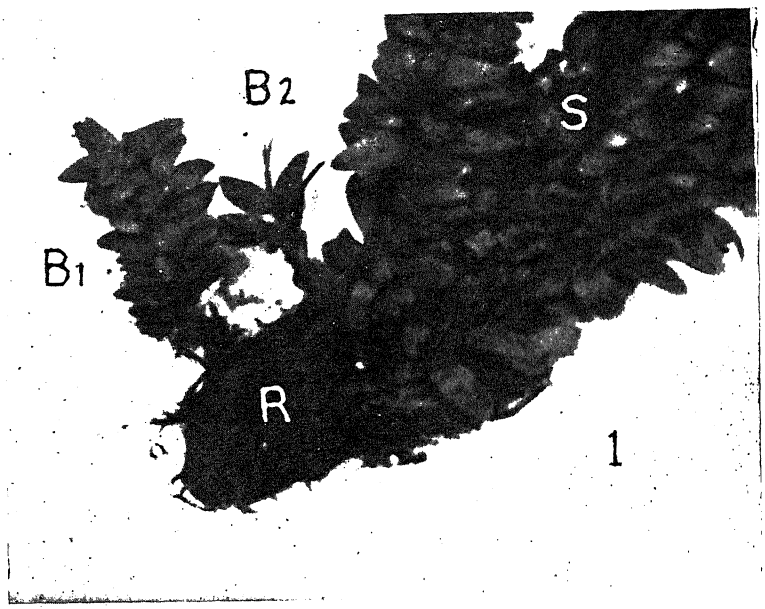
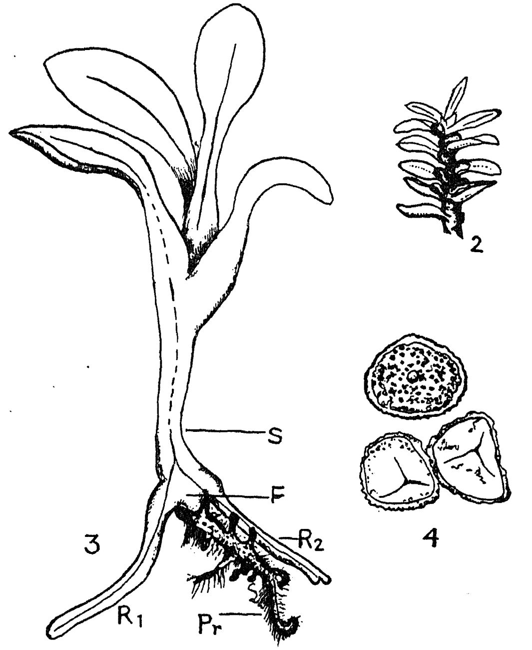



FIG. 1. *L. Hamiltonii* Spring × N. S. R–the mattress of roots at the base of the plant showing suberect branches – S. $B_1$ and $B_2$– bulbils arising from the axils of older leaves from the hinder parts of the plant.

having 6-7 suberect or erect, dichotomised branches. The hindermost part of the plant consisted of a thick mattress of roots which had collected some humus in which were growing small bulbils, and a few sporelings occasionally (Fig. 1). The dichotomised branches were springing from this part and bore sporangia in the axils of leaves towards the apices (Fig. 2). The lower part of the shoots was sterile but a few bulbils were seen developing on them in the axils of some old leaves which possibly had remained dormant during the past years and had not formed the sporangia (Fig. 1). The bulbils were easily detachable from the parent plants and a few of them had fallen on the ground below the tree on which the lycopod was growing: a few of them were also noticeable on the adjoining trees. The species appears to be facultatively terrestrial quite opposite of *L. varium* from New Zealand which is mostly terrestrail but in obtaining 4 prothalli attached to the germ plants growing deep in the humus collected by the network of roots. All the four specimens were fairly well advanced and had sporophytes attached to them. No early stages or the young prothalli were seen, as it was rather late in the season, that this lycopod was collected this year. At the same time to collect or search prothalli on moist slippery branches of trees at a height of about 30-40 feet on tall tree trunks or branches is not an easy task. The young plants attached to the prothalli bear a close resemblance to the bulbils, but they have a very delicate stem with long internodes, and one or two roots only (Fig. 3). They also do not arise in the axils of older leaves or lie there as do the bulbils. As the prothalli in none of the epiphytic species of the genus *Lycopodium* in India have been described, I venture to give here a brief account of the prothallus in this species, notwithstanding the

small number of specimens with me. I hope to give a detailed account if and when some more specimens become available.




FIGS. 2-4. *L. Hamiltonii* Spring. Fig. 2. Apex of a shoot showing axillary sporangia of the *Selago* type × N. S. FIG. 3. The prothallus with a young sporophyte attached to it × 8. S. – Primary shoot ; F-foot ; $R_1$ – first root; $R_2$ – second root on the germ plant ; Pr – prothallus. Note the paraphyses and rhizoids growing in great profusion on the prothallus. Fig. 4. Spores × 220.

The prothallus shown in Fig. 3 is typical of the specimens with me and is probably typical for the species. It consists of a long drawn out, stout central conical portion with several lateral branches ramifying in the humus in which it was found growing. Empty antheridia are noticeable on the lateral branches and archegonia on the central stout conical portion only. Numerous rhizoids and paraphyses are seen all over the prothallus except near the terminal part where the embryo is seen attached to the prothallus. There is no "*Primary Tubercle*" in this species as in *L. cernuum* or *L. ramulosum* (see Mahabalé,[6] 1937). The foot is highly conspicuous and transperent. The lateral antheridia-bearing branches are pale yellow in colour but the central conical part and the lowermost part of the prothallus are dark brown. It is quite evident from this that the structure of the prothallus in this species agrees in general with the structure of the prothallus in other epiphytic species such as *L. Phlegmaria* described by Trueb[7] (1886), in *L. Billardeiri* described by Edgerley[8] (1915) and Holloway[9] (1920), and in *L. lucidulum* described by Spessard[10] (1920).

Further work on the germination of spores and on the other aspects of the plant is in progress.

Department of Botany, T. S. MAHABALE.
Royal Institute of Science,
Mayo Road, Bombay-1,
*March* 12, 1948.

1. Mahabalé, T. S. "Studies on the vascular cryptogams of the Bombay Presidency—Part I," *Journ. Bombay Univ.*, 1938, **6**, 69. 2. Chowdhury, N. P., "Notes on the anatomy of some species of the genus *Lycopodium* in India," *Trans. Nat. Insti. Sci.*, India, 1937, **1**, 189. 3. Mahabalé, T. S., and Deshpande, G. S., "*Psilotum triquetrum* Sw. at Lonawala," *Curr. Sci.*, 1942, **11**, 466, 4. Holloway, J. E., "Studies in the New Zealand species of the genus *Lycopodium*—Part I", 1915, **48**, 258. 5. A few of the plants and bulbils transferred to the Botanical Gardens of the Royal Institute of Science, Bombay, are doing fairly well till now. 6. Mahabalé, T. S. "On the discovery of the prothallus of *Lycopodium* in India," *Journ. Ind. Bot. Soc.*, 1937, **16**, 145-49. 7. Trueb, M., "Etudes sur les Lycopodiacées: II. Le prothalli du *Lycopodium Phlegmaria*," *Ann. du Jard. Bot. Buit.*, Java, 1886, **5**, 87-115. 8. Edgerley, K. E. "The prothalli of three New Zealand lycopods.," *Trans. N. Z. Insti.*, 1915, **47**, 94-111. 9. Holloway, J. E., Studies in the New Zealand species, of the genus *Lycopodium*, Part IV., *Trans. N. Z. Insti.*, 1920, **52**, 193-239. 10. Spessard, E. A. "The prothalli of *Lycopodium* in America," *Bot. Gaz.*, 1920, **63**, 66-76.

## A NEW BACTERIAL DISEASE OF *MANGIFERA INDICA* L.

A bacterial disease of mango, observed on the Agricultural College Farm, Poona, and in the mango gardens at Dharwar in 1947, seems to be similar to that described from South Africa by Doidge.[1] Yet, the pathogen differs in several characters, to justify assigning it a specific rank.

On leaves, the pathogen produces a number of small, angular, water-soaked areas of varying dimensions ranging from 1 to 4 mm. in diameter. These, initially, light yellow, later turn deep brown with a clear halo around the necrotic spots The surface of such spots is often rough and raised due to drying of heavy bacterial exudation. The marginal infection of the leaves results in deformities and cracking. In most cases the spots crowd towards the tip of the leaves. The pathogen is able to infect the petioles, fruits and tender stems.

*Pseudomonas mangiferae-indicae* sp. nov.

Short rods, single or in chains of 2 to 4, 1·44-0·45 $\mu$ x 0·54-0·36 $\mu$. motile, no endospore, non-capsulated, gram-negative.

On the potato dextrose agar, the colonies are circular, smooth, glistening, pulvinate, with entire margin, measuring 1 to 1·5 cm. in diameter after 7 days' growth ; white to creamy white ; no distinctive odour ; gelatin liquefied ; casein digested ; starch attacked ; hydrogen sulphide produced ; litmus reduced ; acid but no gas in dextrose, sucrose, lactose and mannitol ; M. R. and V. P. test negative ; no growth in Cohn's, but fair growth in Uschinsky's solution ; no production of nitrite

indol and ammonia; optimum temperature for growth 27° C.; thermal death-point about 55° C.

Pathogenic on *Mangifera indica*, L. and *Anacardium occidentale*, L.

A detailed account of the disease is forthcoming.

Plant Pathological Laboratory,
College of Agriculture,
Poona,
*April* 27, 1948.

M. K. PATEL.
L. MONIZ.
Y. S. KULKARNI.

1. Doidge, E. M., *Ann. Appl. Biol.*, 1915, 2, 1.

## A PRELIMINARY NOTE ON THE EYE OF *CENTROPAGES FURCATUS* DANA

WHILE the lateral eyes of Entomostraca like Copepoda are of interest because of their specialisation in the higher Crustacea and other Arthropods, the structure of the median-eyes on the other hand, excites interest because of its resemblance to that of the Nauplius. The rotatability of the median-eye has been recorded by Baird in *Diaptomous* castor and by Gerstæcker in *Dias* (Sub-order Calonoidea.) The enclosure of the eye in a special compartment of the body-cavity has been described in *Pontella helgolandica* by Gerstæcker (Pl. 7, Fig. 14). The composite nature of the median-eye is evident from the studies of *Corycœus*, *Sapphirina* (Dana), *Pontella*, *Dias* and *Temora* (Gerstæcker) belonging to the families *Corycœidœ* and *Pontellidœ* and *Calanidœ* by Dana and Gerstæcker. *Centropages furcatus* Dana, a Copepod belonging to the sub-order *Calanoidea*, occurring in the Madras Plankton has an eye capable of rotatory movements lodged in a compartment of the body-cavity and is composed of different units.

The eye is visible as a dark-red spot from the dorsal side and it consists of a bag-like structure with a pigmented quadrangular upper portion and a lower portion with a globular refractive-body lodged in it (Fig. 1, *rb.*) The diameter of the refractive-body is 0·16 mm. and it appears to be constant. Six retinula-cells can be made out in the pigmented-portion (Fig. *rc.*) each of which has a prominent nucleus towards its proximal margin. The cells are all coalescent, with a rhabdom (Fig. 1, *rh.*) in between the adjacent cell-walls towards the dorsal portion. The hypodermis (Fig. 1, *hy.*) appears as two-small thickenings below the cuticular-lens which covers the entire dorsal part of the eye. (Fig. 1, *cl.*)

The rotatability of the eye is due to three muscle-strands, two of which arise from the bases of the first antennæ and are thin (Figs. 1 & 2, *am.*) while the stouter third muscle arises from the posterior region of the cephalo-thorax (Figs. 1 & 2, *pm.*) and is attached to the middle of the pigmented portion (Fig. 2, *pm.*). These muscles rotate the eye to the right and to the left and dorsalwards. Diap-

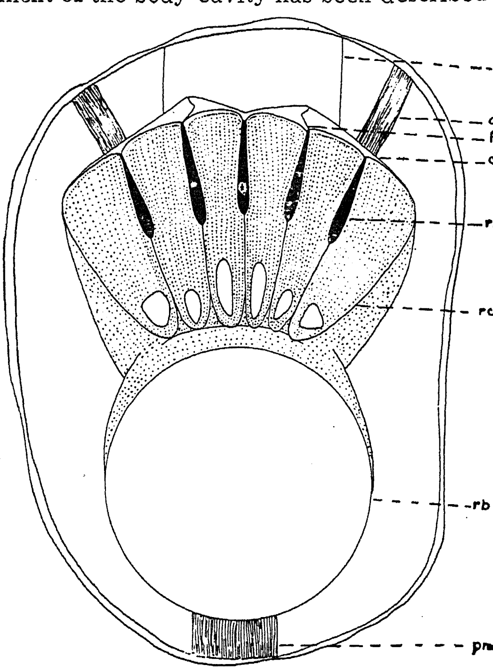



FIG. 1. Latero veutral view.

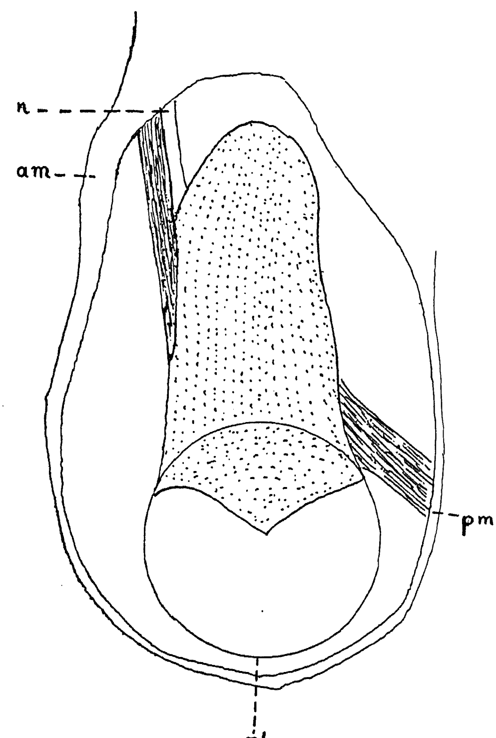



FIG. 2. Lateral view.

*am* — anterier muscle; *pm* — posterior muscle; *hy* — hypoder mis; *cl* — corneal lens; *n* — nerve
*rh* — rhabdom; *rc* — retinula cell; *rb* – refractive body

tomous which has only two muscles, the eye has been found capable of only left and right movements, whereas in Dias, which has four muscles, the eye can be rotated ventralwards as well (Gerstaecker, p. 650). The present form lacks this fourth muscle, and therefore, the capacity of rotating the eye ventralwards is lacking. There are two nerves running from the anterior side of the cephalothorax which supply the eye. When a very narrow pencil of light was projected near the creature, it was found, that the pigmented portion was always pointing towards the direction of light.

The eye is lodged in a papilliform projection of the cephalothorax on the ventral side. This corresponds to *P. helgolandica* (Gerstaecker). The cavity appears to be continuous with the body-cavity.

A brief survey of the median-eyes of copepods like *Pontella, Corycæus,* and *Dias,* as well as the lateral eyes of *Irenœus* and *Pontella,* suggests the wide range of adaptability of the visual organs. This is but one of the several specialisations which clearly show that the Copepods are by no means a simple basal group in the main line of evolution of higher Crustacea, but a highly evolved group with a number of different specialisations which, however, are not of phylogenetic value.

I am thankful to Dr. C. P. Gnanamuthu, M.A., D.SC., F.Z.S., Director, Zoology Laboratory, University of Madras, for translating some papers in German. I am also thankful to Mr. P. Vijayaraghavan, B.SC., for preparing the diagrams for publication.

Zoology Laboratory, S. KRISHNASWAMY.
University of Madras,
Chepauk, Madras,
*May* 19, 1948.

1. Baird, W., "The Natural History of British Entomostraca". Ray. Soc. London 1850. 2. Gerstaecker, Crustacea, Die Klassen und Ordnungen der Arthropden. 1866, p. 650.

## ON THE BIONOMICS OF *CATLA CATLA* (C. AND V.) IN SOUTH INDIAN WATERS*

THE bionomics of *Catla catla* have been partly studied in Bengal[1]; this note gives observations on the species from South Indian waters.

*Distribution.*—Day[2] has not recorded this species south of river Kistna. After the introduction of the fish into the Kurnool-Cuddappah canal by the Madras Fisheries Department in 1909, it has migrated into the Pennar and other waters in Nellore District; and the fish was first recorded in the markets of Madras City in 1912.[3] Thanks to the intensive transplantation of the species into all waters in the province,[4] the fish now forms a major fishery in the Cauvery and has also been stocked in the neighbouring states of Cochin, Mysore and Travancore.

*Food and feeding habits.*—Catla is both a surface and a midwater feeder. Occasionally it browses along the marginal substratum to feed on molluscs. The observation of Thomas[5,6] that adult Catla feed on fish fry could not be corroborated. The composition, in percentage of volume, of the food of the species usually is (1) diatoms and desmids—25%, (2) crustaceans—25%, (3) vegetable matter—30%, (4) protozoa—7%, (5) polyzoans and rotifers—2%, (6) sand particles—3% and (7) other miscellaneous items—8%.

*Breeding.*—Catla attains maturity when 22 inches in size. The ripe ovarian egg measures 1·03 to 1·25 mm. in diameter. Spawning occurs in rivers from July to November. Breeding grounds are furnished by shallow rivers with submerged rocks or emergent vegetation, turbid water and a rapid flow.[7] The temperature of such environments ranges from 22 to 28° C.

*Development.*—The fertilised egg is spherical, 4·38 to 5·10 mm. in diameter, transparent, demersal and without oil globules. Segmentation commences about 40 minutes after fertilisation. The embryo becomes prominent after 10 hours, and measures 2·1 to 2·5 mm. in length. Pulsation of heart commences at 13th hour. Hatching occurs within 16 to 18 hours after fertilisation. The newly hatched larva is 4·38 to 5·25 mm. long, and is characterised by transparent body and conspicuous eyes, gillslits, pectoral fin-buds and median fin fold. The yolk-sac gets completely absorbed at the end of the second day. The larva measures 8 to 10 mm. in length, and possesses large head, red tinged operculum and anterior mouth. The caudal fin gets demarcated on the fifth day. Pigmentation of body commences on the sixth day. A size of 30 mm. is attained in five weeks, when the mouth gets turned upwards. Body becomes greenish-brown in colour, with golden tinges over the head region. The adult characters are completely assumed within another week.

*Importance in rural pisciculture.*—In Madras, the fish has grown to 29 inches and 9 lbs. in the first year of its life. In Madura and in the Willingdon Reservoir in South Arcot, a growth of 3½ to 4 feet and 30 to 50 lbs. within three years has been recorded. Owing to its non-predatory habit and rapid growth, Catla thrives in waters inhabited by other species with a rate of survival as high as 90%. The fish is thus best suited for culture in South Indian waters, the majority of which are non-perennial. The fry have been transported over long distances with a casuality of 3 to 8 per cent. The technique of collection, conditioning and transport of Catla fingerlings has been detailed by Jagannadham.[8]

Inland Fisheries Office, P. I. CHACKO.
8, Ormes Road, Kilpauk, G. K. KURIYAN.
Madras,
*April* 16, 1948.

* Communicated with the kind permission of the Director of Industries and Commerce, Madras.

1. Mokkerjee, H. K., *Sci. and Cul.*, 1945, **10**, 400. 2. Day, F., *Fauna of British India. Fishes*, London, 1889. **1**. 3. Raj, B. S., *Rec. Indian Mus.*, 1916, **12**, 249. 4. Hornell, J., *Adm. Rep. Mad. Fish. Dept.*, 1924, 12. 5. Thomas, H. S., *Tank Angling in India*, Madras, 1887. 6. —, *The Rod in India*, London, 1897. 7. Chacko, P. I., *Proc. 33rd Indian Sci. Cong.*, 1946, **3**, 128. 8. Jagannadham, N., *J. Bom. Nat. Hist. Soc.*, 1947, **47**, 315.

# REVIEWS

**Network Analysis and Feedback Amplifier Design.** By Hendrik W. Bode. (Published by D. Van Nostrand Company, New York, 1945), Pp. 551, Price 45 *sh.* net.

The book is primarily a treatise on general network theory. The omission of general transmission line and filter theory makes it a bit difficult of understanding for the beginner. But the first few chapters make it eminently suitable as a text-book for those who intend to study feedback problems from the design point of view.

The chapter on the design of Equalisers contains practically a summary of various methods and ideas of interest which serve as a good guidance on practical cases of equaliser design. To the best knowledge of the reviewer no text-book published hitherto covers so widely as the present book all the aspects of equaliser design.

The eighth chapter gives a sketch of the theory of analytic function in terms of integrals around closed contours which serves as a mathematical tool for transforming restrictions on the behaviour of network functions at complex frequencies into equivalent restrictions on their behaviour at real frequencies. The chapter also includes a discussion of Nyquist diagram method of determining stability.

The chapter on the graphical computation of relations between real and imaginary components of network functions consists mainly of a set of charts computed from somewhat complicated formulæ. These charts provide a ready method of computation of attenuation phase relation in practical cases. Methods for computing the charts have also been discussed.

The last two chapters on the design of single loop, absolutely stable amplifiers give a new approach to design procedure with illustrations. It may appear that the details of design have been carried out with too much of unnecessary refinement, but on a closer study, it would be evident that such details are not at all superfluous, when one considers the importance of feedback problems.

The discussion on feedback and non-feedback amplifiers with special reference to problems on transmission in wide band systems needs special mention.

The book can be strongly recommended as a reference, especially to those who are engaged in research and development work on feedback amplifiers, both narrow as well as wide band type.

S. K. C.

**Industrial Electric Furnaces." Vol. II.** By V. Paschkis; xiv + 320 pages with 293 figures. (Interscience Publishers, Inc., New York, 1948), Price $ 8·00.

Electric furnaces play a vital role in modern industry as they lend themselves to a wide variety of applications. Apart from the well-known electrometallurgical and electrochemical industries, electric furnaces are being increasingly used in other industries such as the ceramic, plywood, rubber and plastic industries. While the output of books on other branches of electrical engineering is large and steadily increasing, that on electric furnaces is surprisingly small. A book dealing with the modern developments in the science of electric furnace design and operation has been a long-felt want, and the book under review is therefore most welcome.

The subject-matter is covered in two volumes, the first volume (published in 1945) dealing mainly with Electrode Melting Furnaces (Arc type and Arc resistor type) and the present volume with Resistance Furnaces, Induction Furnaces and High Frequency Capacitance Furnaces. In addition the author draws a distinction between furnaces and heat appliances and a few of these are considered under each of the above categories.

The chapter on Resistance Furnaces and Appliances is divided into three sections—Indirect heat furnaces, Direct heat furnaces and Resistor type appliances. The section on Indirect Furnaces is again subdivided into radiation, convection and conduction furnaces and deals with some detail the design of furnace parts, temperature control, conveying mechanisms, resistors, both metallic and non-metallic, controlled atmospheres and other important features associated with these furnaces. The following types of furnaces are dealt with under this classification (*a*) Low temperature furnaces, used for infra-red heating, (*b*) Medium temperature furnaces with metallic resistors, used for hardening, carburizing, annealing, vitreous enamelling, etc., (*c*) High temperature furnaces with non-metallic resistors, used for hardening high speed steels, melting non-ferrous metals and glass, as well as firing ceramic materials, (*d*) Electrode salt bath furnaces, used for heat treatment and (*e*) Externally heated baths. Only a very brief mention, however, is made on the Direct-heat furnaces such as the Silicon carbide furnace. In the section on Heat Appliances an attempt has been made to analyze the basis of design and application of electrical heating in resistance welding devices, soldering irons, immersion heaters, drying machines used in laundries, heaters for cereals in grain elevators, etc.

Without in any way belittling the value of the book it might perhaps be pointed out that more emphasis on the application of "Kanthal" resistors would have been desirable. These resistors manufactured in Sweden are now being widely used in high temperature resistor furnaces for temperatures beyond the range of nichrome resistors (*viz.*, between 1150° C. and 1250° C.). Again while dealing with the subject of heat appliances a reference to electric boilers would have been very fitting. These have been mostly developed in Switzerland and several of them are reported to be in successful operation. The book leaves a general

impression that it reflects more of American practice rather than of European practice.

In the chapter on Induction and High-Frequency capacitance heating, emphasis is laid more on the thermal aspects and the relationship between electrical and thermal problems rather than the electrical fundamentals of induction and capacitance heating. Under induction furnaces both the core type and the coreless types of furnaces are described and questions of high frequency power supply, selection of frequency, design features, control equipment and special fields of application are also discussed. High frequency induction appliances are grouped into "surface heating" (such as hardening and brazing) and "through heat heating" (such as annealing and forging) jobs.

The next section deals with the main features of high frequency capacitance or dielectric heating and its applications to various industries such as the working of plastics and wood, drying of rayon cakes, dehydration of food, gluing of laminated glass, vulcanizing of rubber, drying of explosives, etc.

The book ends with a chapter devoted to a discussion on selection of furnaces.

Bearing in mind the immense scope of application of electric furnaces in industry, it would not be right to expect a book of this type to cover the whole field. Nevertheless, the author has made an admirable attempt to introduce a fairly rigid classification of furnaces to enable him to present the fundamentals of such design and operation. There is no doubt that the book would be a valuable guide to the furnace engineer using the furnaces, as well as the furnace designer and the power sales engineer. Numerous references to current literature given throughout the volume enhance its usefulness considerably. The printing and get-up are first rate. The riviewer was unable to find the price marked anywhere on the book.

H. N. RAMACHANDRA RAO.

**Christian Huygens and The Development of Science in the Seventeenth Century.** By A. E. Bell. (Edward Arnold & Co. London, 1947), Pp. 220. Price 18/- net.

This is one of the several biographical books published by Edward Arnold & Co., and furnishes an important link in the presentation of History of Science. Part I of the book records notable events in the life of Huygens. Part II deals with Huygens's scientific work and its relation to the state of science in the seventeenth century.

Christian Huygens came of a family which had already shown genius. His father, a man of outstanding ability and brilliance, completed a course of law, showed distinction in mathematical work, was a diplomat by profession and an amateur musician and painter. Huygens himself had interests ranging over a variety of subjects. He built his own telescopes, observed Saturn's rings amongst many other phenomena, made his own clocks and worked with several mechanical devices. He made notable contributions to several branches of science. Astronomy, dynamics and physical optics stand out prominently. He is to be regarded not only as a great thinker of his age but also as a scientific genius of all time. In his own world he was incomparable and "was one of the greatest ornaments of this time".

The book is an excellent exposition and contains a critical account of Huygens's scientific work. Huygens's contributions to physical optics, in particular his wave theory of light, are described in some detail in the book. The author has succeeded in presenting it in proper perspective in relation to the work of Huygens's contemporaries. For a student of the History of Science, it will be an invaluable acquisition.

S. BHAGAVANTAM.

**The Differential Geometry of Ruled Surfaces.** By Dr. Ram Behari, Lucknow University Studies, No. XVIII. Pp. 94.

This is a monograph dealing with certain particular aspects of the theory of Ruled Surfaces in three-dimensional space with regard to whose properties and the methods of derivation thereof, Dr. Ram Behari has made valuable contributions. The scope of the book is indicated by its principal contents, *viz*, properties of the line of striction, properties of generators, curved asymptotic lines, ruled surfaces of a rectilinear congruence, and deformation of ruled surfaces. Amongst the original contributions of the author, the most interesting in the reviewer's opinion, are his investigations on osculating quadrics, and on the pitch of a pencil of a rectilinear congruence. The bibliography given at the end will be valuable to workers in this field. The monograph should be in the hands of every one interested in this particular branch of geometry.

C. N. S.

**The Identification of Trees and Shrubs.** By F. K. Makins. (J. M. Dent & Sons Ltd., London), 1948. Third impression (Revised). Pp. vi+375. 2800 diagrams. Price 21*s*. net.

In books on plant systematics the method adopted for the identification of plants is based primarily on floral characters, supplemented by characters of other organs such as foliage, fruits, etc. The author of the book under review has, however, adopted a novel method for the identification of shrubs and trees of British Isles. In this the orthodox method is reversed, and identification is based in the first instance on foliar characters which is supplemented by floral and other characters. The advantage of this novel method lies in the fact that plants could be identified out of season when they are not in flower. With the aid of accurately drawn diagrams and the key provided, identification is made simple and easy. From the reference provided in the legends to the diagrams a description of the plant is obtained to complete its identification.

The book is written to serve the needs of professional gardeners, amateur plant collectors and others interested in plants. A special feature of the book is that technical terms are used to the minimum. The inclusion of a glossary of terms used has added to the value of the book. There are 2,800 diagrams which

are grouped according to the shape and arrangement of leaves. With the aid of these diagrams over 1,300 species belonging to 534 genera can be identified. A list of authors of botanical names and an index are provided.

The utility of the book can be judged from the fact that, first published in 1936 it has reached the third revised impression. Although the book restricts itself to shrubs and trees of the British Isles it could be of use to plant collectors outside Britain since a great majority of the trees and shrubs of the British Isles are introduced exotics.

L. S. S. K.

**The British Aircraft Industry, 1948.** (Society of British Aircraft Constructors Ltd., 32, Savile Row, London, W.1.), Pp. 279.

This is a directory of the members and associate members of the Society, giving particulars of the directorate, the principal manufacturing interests, production lines and specialities. The achievements of the firm, if any, during the world wars are briefly indicated.

The Directory is an extremely useful mine of information relating to the production of aircraft and its accessories. The volume will be welcomed not only by those who are directly interested in aircraft construction but also by research engineers and technologists seeking accessories and subassemblies for the construction of instruments and machines of their own design.

The text is given in all the three languages, English, French and Spanish, thereby extending the usefulness of the volume to practically every part of the Globe.

**The Purums: an old Kuki Tribe of Manipur.** By Tarak Chandra Das. (University of Calcutta), 1945. Price Rs. 10.

The volume under review is, according to the author, the outcome of five field trips during 1931-36 undertaken at the suggestion of the Political Agent of Manipur, Mr. J. C. Higgins. Much of the closely packed information that is presented in its pages was collected at interviews through the medium of Meithei interpreters. The way in which the routine of tribal life is observed and recorded is detached and objective.

The anthropometric measurements cover the entire adult male population. The Purums are short statured and mesocephalic with mesorrhive or leptorrhine noses and highly depressed nasions. They have medium lips and chins, coarse hair and their zygomatic arches are not at all prominent.

The Purums inhabit 4 small villages in Manipur State on the border of Burma, and the number according to the Census of 1931 is 303 (145+158). Their economic life is characterised by 'jhuming' which is supplemented by plough cultivation. The change from shifting agriculture to the use of the plough has entailed on the tribe certain far-reaching changes in its entire organisation and culture. One of the most prominent of such changes is the gradual decline of ultimogeniture which is giving way to an equal share of the property to all the sons.

Purums' social organisation is patriarchal, and the household is of the biological or the limited joint family type. Cross cousin marriage of one type, *i.e.*, marriage with the mother's brother's daughter is enjoined while the opposite type of marriage with the father's sister's daughter is prohibited. Marriage is by service with the bride's family for three years, and no bride-price is paid. Widow remarriage is permitted, and usually takes the form of the levirate. Purum customs in relation to birth, puberty, marriage and death are essentially tribal, but show perceptible signs of Meithei or Manipuri influences. The dead are buried and ancestral spirits are venerated. Purum religion is largely Hinduized, and their pantheon includes, besides tribal gods, Rama, Krishna, Mahadeo and Kali. The Purums have four annual festivals each connected with a particular deity and characterized by dance, song and ritual. Shamanistic practices are equally prevalent and the office of the medicine-man is not hereditary but by initiation of the novitiate.

The Purum village is autonomous and governed by a council of village officers elected on a basis of merit and promoted according to seniority. Social rank is attained by giving prescribed feasts of merit. The village officers collect rent and settle disputes. With settled and peaceful conditions the offices have lost much of their power and dignity and are thrust on youngsters.

The Purums have a lunar calendar. They have no system of weights. Though musical instruments are used on all festive occasions, the artistic activities of the tribe find little scope or outlet.

Mr. Das has suggested a number of reforms in concluding his paper with an apotheosis of functionalism. Among such are improvements in the personal hygiene and rural sanitation of the tribe, the growing of a suitable variety of cotton as a cash-crop together with encouragement of spinning and weaving, the growing of fruit trees as a food crop, cattle rearing and the inclusion of milk in the tribal dietary, the provision of means for interesting the tribe in artistic activities and the resusciation of their now moribund ruishang or bachelor's hall as a nexus of social activities.

The get-up of the book and the photographic illustrations leave much to be desired. A number of genealogies are included in the book. The terms of address and marital relations are set forth in a number of tabular statements. A glossary and an index add to the usefulness of the volume. But the book is rather highly priced at Rs. 10/-.

C. H. JAYADEV.

**The Graphic Arts.** By William H. Johnson and Louis V. Newkirk. (Publishers: The Macmillan Company, New York and London), 1942. Pp. i-vii plus 1-160. Price 14s. net.

In the foreword to the book, the authors have written: "This volume, one of a series on industrial arts education, is a pupil text intended to introduce youth to the field of the graphic arts." This idea they have kept well in mind in dealing with the subject throughout the book. Without going too much into technical details, the book introduces the reader to the several processes involved in producing a book.

In Chapter I the authors say: "The divisions of the graphic arts industry are printing, etching and engraving, photography, bookbinding and drawing." In the subsequent chapters these subjects are dealt with so as to give the reader a general idea as to how these are carried out.

The first chapter is introductory dealing on the subject in a general way and gives a brief history of the development of printing.

The next four chapters deal with the production of print from type. The manufacture of type is briefly explained. The methods of setting type by hand and by machines are described. The various kinds of printing machines, from the hand press producing a few hundred copies an hour to the rotary machine producing 50,000 copies an hour and the purpose for which each is best suited are explained.

Chapters VI to VIII are devoted to the printing of illustrations. The different kinds of blocks and how they are prepared and printed are described in these chapters. The preparation of linoleum engravings and their use is dealt with in detail, a separate chapter being devoted to it.

The subject of lithography is disposed of in four short paragraphs. It would have added to the usefulness of the book if this subject was dealt with more fully.

Silk-screen printing is the subject of Chapter IX. Though linoleum engraving and silk-screen printing are simple and cheap methods of producing illustrations, these have not found favour with printers in India, either because these methods are not commonly known or because printers do not wish to be bothered with them when line and halftone blocks are easily available at cheap prices.

Chapter X deals with estimating and cutting paper stock. Some reference is made to estimating. This is an important subject and the authors might have devoted a separate chapter and gone into the subject in some detail.

Chapter XI describes several kinds of duplicating machines and their working.

The next two chapters take the reader through the bindery and explain fully how the binding of books of different kinds is carried out.

Paper making is the subject of the next chapter. Here is described the making of handmade and machinemade papers. The simple tests given for testing paper without elaborate laboratory equipment, ought to be of great help to people who buy paper in large quantities.

Photography which is a subject closely connected with printing is the subject of the last two chapters.

At the end of each chapter is given a set of questions on the subject dealt with in the chapter. This will be of great use to the student. The bibliography at the end of each chapter will be of use to readers who want more information on the subjects dealt with in the several chapters. A useful index is given at the end of the book.

The book is profusely illustrated. The illustrations are of great help to the reader in understanding the text.

The book is written in simple language without the use of many technical terms. As a book to introduce the pupil to the graphic arts, it is eminently suited.

B.S.I.

**Science News 6.** Penguin Books. Pp. 144, 1948, price 1*sh*. net.

Vol. 6 of Science News contains a miscellany of articles on recent developments in the field of physics, agriculture, biology, medicine and glaciology, presented in such a manner as to be comprehensible to the layman and of interest to the scientist wishing to keep up with current scientific research other than in his own field of specialisation. Of particular is, "Report on Antarctica" in view of the recent political interest in the south polar regions.

V. B.

# SCIENCE NOTES AND NEWS

## Dr. C. S. Pitchamuthu and Mr. B. Rama Rao, Department of Geology, Mysore

Dr. C. S. Pitchamuthu, Superintendent, Intermediate College, is appointed as Director of Geology in Mysore. His original contributions to geological science are well known to readers of *Current Science*. He was elected President of the Section of Geology at the Delhi Session of the Indian Science Congress in 1947. We are confident that, during his regime the Department of Geology, which has always enjoyed, thanks to a succession of distinguished Directors, the reputation of being one of the progressive scientific departments in India, will make even greater advances in scientific and technological fields of geology and contribute towards the wealth and prosperity of the State.

Mr. B. Rama Rao, who has been granted leave preparatory to retirement has been entirely responsible for initiating many schemes pertaining to the exploitation of the mineral wealth of the State. The discovery and working of the Bellara Gold Mines is due to his vision and enterprise. Mr. Rama Rao leaves to his successor Dr. Pitchamuthu, an inspiring tradition, an efficiently organised and well equipped department, and a ten-year programme of development.

## Dr. A. L. Narayan

Dr. A. L. Narayan, till recently Director of the Kodaikanal Observatory, has been appointed Principal of the Maharaja's College, Vizianagram. He was connected with this institution as Professor of Physics and Director of Research Laboratory during 1914-18.

## Indian Dairy Science Association

The first General Body Meeting of the Indian Dairy Science Association was held on the 15th May 1948 at 5 p.m. at the premises of the Indian Dairy Research Institute, Bangalore, with Sir Datar Singh, Vice-Chairman, Indian Council of Agricultural Research, in the chair. A distinguished gathering of local scientists, members of the Association and students of the Indian Dairy Research Institute participated in the proceedings.

The General Body ratified the Constitution and Rules of the Association and also elected the office-bearers and members of the Executive and Editorial Committees. Sir Datar Singh was elected as the Hony. President of the Association.

In the course of his presidential address Sir Datar Singh pointed out that this Association fulfilled an urgent and long felt need for an organisation which could co-ordinate and unify the activities of the dairy scientists of the country towards one common purpose, namely the rapid advancement of the nation's dairy industry. Dairying held a very important position in the Agricultural economy and prosperity of the country, and for quite a long time—they had been acutely conscious of the necessity for not only increased producion of milk but also improvement of its quality, its marketable life and its economic utilization in subsidiary food industries. If these problems were to be tackled successfully, intensive research work was called for on the best method of preservation of milk, production of clean milk, better handling and marketing of milk and milk products, etc.

The first issue of the Indian Journal of Dairy Science is expected to come out shortly.

## Sugar Research Foundation, Third Annual Award

For research that promises to develop common sugar as a key raw material of industry, Dr. Leslie F. Wiggins, of the University of Birmingham, England, was awarded the Third Annual Sugar Research Prize of $5,000. At a dinner held at the Hotel Biltmore, Dr. Vincent du Vigneaud, Professor of Bio-Chemistry, Cornell University Medical College, presented the prize in behalf of the National Science Fund, which administers the award program. Dr. Robert C. Hockett, Scientific Director of the Foundation, described the work of Dr. Wiggins as "a milestone in the advance toward better use of cheap and abundant plant products to serve the myriad needs of civilization.

"With the depletion of coal and petroleum reserves," he said, "greater dependence must be put on utilising the continuing supply of material produced by growing plants. Among these abundant materials sugar is undergoing careful study because chemists have learned how to produce vast quantities at low cost."

The first Sugar Research Foundation Prize was shared by Drs. W. Z. Hassid, H. A. Barker, and Michael Duodoroff for the first synthesis of sugar which has made possible "tracer" studies of the metabolism of sugar in the human body. Dr. Carl F. Cori, recent Nobel Prize winner, received the second annual award last April for his contributions to the knowledge of how the body uses starches and sugars.

## Flying Display and Exhibition in September, 1948

The Society of British Aircraft Constructors, 32, Savile Row, London, W. 1, will hold its 9th Flying Display and Exhibition in September this year. The capabilities of the latest British civil and military aircraft and engines will be demonstrated in flight, and presented for inspection on the ground.

In addition to the Flying Display, a Static Exhibition on the aerodrome of aircraft engines, aircraft accessories, materials and parts, will show the latest developments in British aeronautical equipment, and will provide a complete survey of the products of the Aircraft and associated Industries.

## Andhra University

The M.Sc. Degree in Mathematical Physics of the Andhra University has been awarded to the following research scholars :—

1. K. Subramanya Sarma, 2. S. Krishna Kutty Nair.

## Delhi University

Dr. M. L. Bhatia, Ph.D., D.Sc., Reader in Zoology, University of Lucknow, has been appointed Reader and Head of the Department of Zoology, which has been started this year in the Delhi University. Dr. Bhatia's special subject is general morphology with particular reference to *hirudinea*.

Mr. L. N. Johri, M.Sc., formerly of Rangoon University and till lately Research Assistant to Professor K. N. Bhal of Lucknow University, has been appointed Lecturer in Zoology, Delhi University.

## Lady Tata Memorial Trust Scholarships and Grants for the Year 1948-1949

The Trustees of the Lady Tata Memorial Trust announce on the 18th June 1948, the death anniversary of Lady Meherbai Dorabji Tata, awards of scholarships and grants for the year 1948–1949.

The International awards for research in diseases of the blood with special reference to Leucæmias are made to Dr. & Mrs. Paterson (England), Doctors, Peter A. Gorer (England), Edith Paterson (England), Jorgen Bichel (Denmark), Pierre Cazal (France), Johannes Clemmesen (Denmark), Guido Totterman (Finland), C. P. M. Plum (Denmark), M. C. Bessis (France), Simon Iversen (Denmark), A. Kelemen (Hungary) and Prof. Edoardo Storti (Italy).

Indian Scholarships of Rs. 250/— per month each one year for scientific investigations having a bearing on the alleviation of human suffering are awarded to Miss V. Shanta Iyengar (Bombay), Messrs. Suprabhat Mukerjee (Calcutta), Yashwant Balkrishna Rangnekar (Bangalore), Gangagobinda Bhattacharya (Calcutta), K. Ramamurti (Bangalore), and B. K. Sur (Bangalore).

Editor: M. Sreenivasaya, B.A., F.I.I.Sc., F.A.Sc.
623-48 Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore

Current Science

Vol. XVII] JULY 1948 [No. 7



# INDUSTRIALISATION AND THE NATIONAL GOVERNMENT*

I often ask myself why a country like Canada, Australia or the United States of America is so prosperous and why India happens to be backward and poor. How are the citizens of the countries named able to live to twice the age that our people in India do, and how have they managed to raise their standards of living to their present high level and lead prosperous lives?

The reasons are plain. More than 85 per cent. of the Indian population is illiterate; the bulk of them have no idea of present-day world trends, of the changes that are going on in the conditions of existence and of the moral obligations and material precautions which could give them protection and safety. They do not know, for instance, that modern nations have acquired power and strength because they train themselves and give great attention to industries and earn larger incomes from industries than from agriculture. The Indian rural citizen who forms the great bulk of our population has a dislike to give up traditional habits, he has no idea what practices and behaviour really lead to profitable living, and he has no plan of life. When an Indian workman in the interior happens to have sufficient money in his possession to keep his elementary needs satisfied for a fortnight, he dislikes work and is inclined to take a holiday. His mind is not trained to take thought of the future and he has not got the capacity for group effort to promote beneficent practical ends on any appreciably large scale.

The main reason is illiteracy and ignorance, and the principal remedy to remove these defects is the long-range one of mass education.

One other special remedy for these weaknesses is for the Government to appoint boards or committees of leading men of

* Presidential Address by Sir M. Visvesvaraya, at the Second Quarterly Meeting of the Central Committee of the All-India Manufacturers' Organisation, July 11, 1948.

known probity and high character and charge them with the duty of preparing Rules of Conduct and Models of Behaviour, the practice of which is common among modern nations, and circulating the same by attractive propaganda. Good things will not come to our citizens without effort and preparations. We have to work for them; hence this suggestion that we should compare ourselves with nations who are leading orderly lives and are prosperous, and prepare slogans and leaflets based on such comparison to induce our large static population to lead more active and disciplined lives and thereby become more useful to themselves individually, and to the Indian nation collectively.

### The Industrialists' Difficulties

The country's weaknesses as stated before are due to the traditional habits and unplanned life of the people and particularly to neglect of industries. The previous Government was by its very nature opposed to rapid industrialisation. The present Government is national and the business public expected much from it. They had hoped that all the handicaps that existed formerly would be removed at one stroke and that the business public including the labour population would benefit greatly by the change. In the opinion of business men who are in close contact with manufacturing activities in foreign countries, there is disappointment that problems are not widely and openly discussed and correct policies are not frequently enunciated to give confidence and hope to the public.

I asked a few business friends of our Organization in Bombay to meet together and give me a brief list of the impediments to industrial progress at the present time. Their statement is comprised under six heads, which, summarised, reads as follows:

1. *Raw Materials.*—Imports and supplies of essential industrial raw materials are, it is stated, restricted and controlled. Consequently delays occur and industrial operations, etc., suffer. Examples of such materials are steel, pig iron, virgin metals, industrial processing materials, fine chemicals including most of the organic chemicals, industrial solvents, industrial fuels and machinery.

It is recognised that there is a world shortage of all these materials, but a more business-like handling of the representations and complaints of delay by Government staffs could, it is said, very greatly ease the situation.

2. *Transport.*—Much inconvenience is caused by difficulties of transport. Cement is being produced in sufficiently large quantities but the A.C.C. Ltd. have had to close down two of their factories. Corruption and inefficiency are also said to be rampant which create artificial shortages. If the transport situation does not improve many other industries may have to be closed down similarly.

Shortage of petrol and diesel oil have curtailed the more general use of road transport. Coastal shipping has not sufficiently recovered from war effects. No systematic attention is paid to the development of internal river transport.

3. Provincial Governments very often adopt new policies without giving previous notice to the public. Orders are often issued which interfere with the regular operations in industries or the sale of their products without giving sufficient previous intimation.

4. Provincial trade barriers are created by restrictions put on the movement of specific materials like oil seeds or milk products or timber or machinery. The resulting necessity of obtaining licenses and permits leads to inordinate delays, corruption and hardship to all concerned.

5. Ministers of Government sometimes express views which place impediments in the way of new industrial ventures and discourage investors. The opinion is widely held that the premature anxiety of the present Government for socialism and nationalisation is responsible for a feeling of nervousness about the country's economic future.

Individual members of Government may hold socialistic views but they should not give expression to them unless their colleagues in the Cabinet have also accepted them. Such expression leads to uncertainties and loss of confidence.

6. *Labour Difficulties.*—Industrial production has fallen and costs of products have risen by frequent strikes. Costs of production are rising and there is a falling off in the quantities of manufactured goods. The present situation is attributed to the desire of some of the Ministers to please the working classes in order to be able to obtain their political support at the first election that may take place when the new

Constitution is adopted. Labour, it is said, is made a pawn in the political game. Even socialists and communists are said to be fomenting labour troubles and holding out impossible promises with a view to catch the labour vote.

Since the organized industrial labour forms less than 2 per cent. of the total population, such attempts at bolstering up the economic condition of the workmen at the cost of the remaining 98 per cent. of the population cannot but lead to great hardships and loss to the entire country.

### First Step should be to Strengthen Defence

Industries needed to strengthen the country's Defences should be given preference over every other case which is working for profit.

As regards technological knowledge the most urgent need is to train people in mechanical engineering, chemical technology and other special subjects for the maintenance of a strong defence force for the country. Government may be satisfied with the adequacy and efficacy of their military arrangements; but in a democracy the public who give thought to these subjects will want sufficient information to be assured of the safety and security of their country against possible foreign aggression.

In America and Canada the national leaders are acquainted with defence arrangements and can get full information regarding the fighting strength of their people and also of their comparative international strength if they wish to have the information.

In India hitherto persons interested in such topics were not allowed even to look over the fence. Military secrets need not be revealed but it is hoped an early change will come over the attitude of Government and a good number of leaders in all parts of the country will be able to keep watch over the growth of the country's military strength.

The British Cabinet issues a White Paper periodically to give assurance to its public in this respect. The latest paper issued bears the title "Statement relating to Defence in 1948". The British public often enquire whether a sufficient number of leading men are retained in the Army and whether conditions in service establishments are sufficiently attractive to draw a fresh supply of talented younger men.

There is great need that similar statements to assure the public that the country's security is closely watched, should be issued in India.

### No Statistics Available of Existing Industries

This is an elementary duty of any Government interested in the business life entrusted to its care. The British Government were not in favour of any statistical measurement of the results of their Administration.

In Canada and Australia, progress in industries in such matters as:

Number of establishments,
Capital invested,
Number of employees,
Salaries and wages paid,
Cost of materials,
Quantity and gross value of products produced, and
*Per capita* value of output,

are published once a quarter.

I have been appealing to Government in this country to remedy this defect ever since I took an interest in economic matters, both in public addresses and by publications. An Indian Economic Enquiry Committee appointed by the Government of India in 1925 of which I happened to be the Chairman made specific recommendations for collection of statistics. But no serious attempt was made by any responsible head of the administration at that time or subsequently to remedy this grave defect or even to discuss the proposals in public.

The capital invested in and the *per capita* income derived from industries, if correct statistics be available, will give an idea of the progress of the country in industrial activities and towards industrial prosperity.

A legislative enactment has been passed to collect statistics but the Government have not enforced it everywhere. It is understood statistics have been collected for about 40 per cent. of the industrial establishments. These by themselves will be of little value to assess the progress made unless all the establishments are brought into the picture.

The present Government has been in office for less than a year and they cannot be held responsible but they must give the

public an idea of what they are doing and how soon this age-long defect will be remedied.

### Three Institutes of Technology

It is learnt that the Government of India have decided to establish two Institutes of Technology, both of them on the M.I.T. model, one in or near Calcutta and the other in or near Bombay.

It is also gratifying to learn that certain prominent leaders in South India have decided to start an Institute of Technology in Madras City. Although the resources so far offered are slender, the initiative taken in this case is most praiseworthy.

Great care is necessary to see that it does not take much time to equip these three institutions with buildings, machinery, staff and essential apparatus and furniture. Here is an opportunity for Government to lay aside routine methods and resort to some kind of serviceable rush tactics. Otherwise it might take decades before satisfactory institutions in these three cases come into view. Since the private endowment for the Madras Institute is small, it is the duty of the Government of the Province to go to its rescue and make liberal grants.

One way of getting this done is by appointing a Sub-Committee of three leaders (or one capable reliable man if one such both reliable and capable could be found) to help to construct buildings for, and *equip these three institutions* speedily on a contract basis. Respectable firms should be invited to consider the proposal. It must be recognised that Government establishments will not be adequate to cope with the demands in this respect within a reasonable time.

The times are abnormal, the need for developments is urgent and the procedure to be resorted to to gain the objective, even if unusual, should not be rejected.

Respectable business firms may come forward and undertake to do their best if the transaction is entrusted to their care as in the case of contracts in war time. In such cases the risk must be taken ; a good offer should be accepted. In the present circumstances it would not be inappropriate for a Minister or the Cabinet to invite offers, formally or otherwise, and accept any reasonable proposals finally with the approval of the majority of members of the Cabinet.

### Past Attempts to Establish Technological Institutes

There is a sorry tale to tell of past attempts at establishing such institutions in Bombay and Calcutta.

It is probably not remembered that the establishment of an Institute of Technology on the model of M.I.T. was recommended by a Bombay Government Committee in 1921-22. The Indian members of the Committee unanimously supported the proposal while the European members opposed it and the Bombay Government of those days shelved the whole report.

The University of Bombay being dissatisfied with the Government attitude to a problem of this importance appointed a committee of its own to arrange for instruction in Chemical Technology. That Committee recommended the establishment of a University Department for the purpose. The Department has been since established and is now working satisfactorily in the quarter of Bombay known as Matunga.

The Institute now proposed to be established in or near Bombay will, it is hoped, be mainly to promote knowledge and skill in higher technology in engineering and research in industries, in the first instance, and to enlarge the same gradually by adding new departments as funds and experience become available.

They have a National College of Engineering and Technology at Jadhavpur in Calcutta which is entirely independent of Government help or control but owing to its slender resources, the scope of instruction attempted is limited. I understand no Government grant was asked for nor given. I have not yet heard whether the new Government of West Bengal has begun to give substantial help to this very deserving institution.

### Present Three Urgent Wants of Industries

Some of the more urgent wants of industrialists and business men at the present time are capital, machinery and experts.

No country can be said to be militarily or economically self-contained and strong if the people are not trained to manufacture heavy and delicate machinery and tools. India cannot be regarded as an Industrialised Modern State if its skilled public is not equipped with such capacity.

I have dealt with the question of the need of capital in the previous discussions. Heavy industries cannot be developed without large investments in the shape of capital. Canada has invested about Rs. 2,500 crores of capital and the benefit to that country is that the gross value of products manufactured annually is more than Rs. 2,500 crores. Similar results or even comparatively better results may be expected in the early days of this new development in this country.

It is feared that this aspect is not given the importance due to it by the authorities in power either in New Delhi or in some of the Provinces.

Nationalisation would be quite good as a policy for the manufacture of defence machinery. Some few small Government plants exist on the Bengal side which were started in the days of British rule. Nationalisation of selected key industries which do not pay business men to take up may not be objectionable. Government management will not be economical in the present circumstances. This frequent reference to nationalisation by Government authorities has unnerved industrialists and business men and confidence is shaken throughout India. I do not know what steps Government of India are going to take to bring back confidence to investors and make the wheels of industry go round smoothly in future.

### Prospects of Obtaining Help from Big Industrial and Financial Corporations of U.S.A.

America has been willing to supply these wants namely, machinery, experts and even capital.

It is true on account of the last war the manufacturing countries in the West have had to replace the worn-out plant of their own industries and it is difficult for them to supply what this country wants in proper time. But there are various ways of getting over the difficulty.

I can speak from personal knowledge that large financial firms in America like the financial firm of Rockefeller of New York are willing to help this country in this emergency if only there is a satisfactory understanding between the two countries at the Government level to remove impediments and allow facilities to flow freely into India from that quarter.

It is not meant that Government should take any financial responsibility. The financial firms in America should be placed in contact with the business firms in India who undertake to organise large-size industries. It will be a transaction between the business Boards or managing agencies in India in charge of large industries and financial and other firms in America who are accustomed to export machinery and supply of experts for setting up industries of large size in foreign countries.

The financial houses have access to trusted groups of manufacturers, technologists, machinery manufacturers and others in their country and they are willing to supply to any important undertaking in India all that the latter may want. They feel a sense of responsibility for all work undertaken through their agencies.

When blue prints are ready, orders may be placed with the industrial groups under the influence of the parent financial firm. The latter will take the responsibility for fair dealing to a certain extent.

The supply of machinery can be quickened. The financial firm will organise and place valuable facilities at the disposal of promoters of any industry in this country provided the promoters make it worth its while.

Business men in India know how the late Mr. C. P. Perin of New York helped to build the first steel industries in India. Men of Mr. Perin's calibre and probity can be had even now if a close search is made for them. But they must be paid high fees and remunerated liberally. Mr. Perin was paid a fee of Rs. 25,000 to Rs. 30,000 per month for the time he spent in India. I can say from personal knowledge of the services he rendered that he was not overpaid at these rates.

Next to the understanding between the Governments, money can buy anything that is wanted if not from U.S.A., at least from one or more smaller countries of Europe. The supply of machinery can be also quickened if in special circumstances sufficiently high prices are paid to make it worth the while of manufacturers to supply them.

As stated above next to the understanding between two Governments money can buy anything which our industries require if not from U.S.A., or U.K., at least from the smaller countries of Europe

like Sweden, Switzerland, Hungary and Czechoslovakia, among others.

### Some Few Developments Considered Very Necessary

Some few important developments are considered necessary in the present industrial organization of the country. These are :—

(1) *Appointment of a Deputy Minister.*—The industrial needs of more than 300 million population are entrusted along with the question of supply to one Minister. In spite of very able men being in the Ministry, in spite of their exceptional very hard work, big questions necessarily take a long time to get settled and delays in current matters create untold hardships to the industrialist public. The appointment of a Deputy Minister seems necessary who should be made responsible for the routine business of the Department leaving the Chief Minister time to get into closer contact with leading manufacturing firms and industrialists.

The addition to the staff of a responsible Deputy Minister ought to help greatly to increase production and minimise malpractices. The present hardships of a vast population will be substantially eased.

(2) *An Economic Council.*—An Economic Council, that is, a representative body to give continuous attention to the economic interests of the country is also a necessary measure to bring Government authorities, officers, industrialists and business leaders into closer contact. This will lead to more rapid promotion of business because the official mind will be better known to the public and the needs of the public better understood by officers and authorities.

(3) *A Liaison Agency.*—It is suggested that two or three members of the Economic Council may be specially selected for employment to be used as a liaison agency both by the Gavernment and the Council. The picked men who would be serving on this Agency may be made to work up schemes in co-operation with promoters of such schemes by collecting all necessary details for them from any part of the country or of the world, by air travel. In this way when pressed for time any large industry can be organised and started in about three months time.

(4) *A Special Bureau or Board.*—A special Bureau or Board should be brought into existence for maintaining a continuous study of the latest developments in industries in Western countries. Much of such information can be gathered also through technical journals and publications. The country should be kept up-to-date by such means in the sphere of industries.

(5) *Decisions and Action.*—The democratic ideal is that decisions should be made by a Committee or other democratic body but that the responsibility for action should be entrusted to one, or a few men, of capacity and character. There is wisdom in a multitude of Councillors but for implementing a scheme or a project, one person of capacity and probity, or a group of three persons of character and capacity, should be selected and given full responsibility for execution. Time, funds to be spent, and the specific form of results expected may be prescribed. In other respects this small executive agency should be given full freedom and discretion. One or two cases in every ten may go wrong but that may be counted as part of the price paid by the country for rapid or efficient execution.

(6) *Machinery Manufacture.*—An effort should be made on an extensive scale to spread the knowledge of mechanical engineering and machinery manfacture in the country. Factories and workshops with this definite objective should be established to make up for past omissions. The people should be given opportunity and freedom to manufacture machinery and machine tools. Rewards should be given for skill in this respect. One Japanese way of development was to take a foreign machine to pieces and distribute the pieces among skilled workmen or students with instructions to each person to prepare an exact counterpart. When all the parts were ready a new machine similar to the original one was produced. This may be taken as one of the many practices which enthusiastic instructors usually adopt to teach the younger generation the ability to manufacture machinery. Due to lack of opportunities for practice, there is an appalling dearth of original thinking and enterprise in this respect in our midst.

(7) *Selection of Experts.*—In order to get satisfactory men from abroad the Government or the business firm concerned

may have to pay two or three times the fee or salary that experts get in their own country. The price paid for securing efficient experts is often a flea-bite compared to the value or the results obtained by securing good men and by making good use of them when secured.

In deciding all these matters the broad facts should not be ignored that we are dealing with the country's industrial production which the modern world considers to be of the greatest value for any country's protection from foreign aggression and protection from want, and we are dealing also with a national emergency brought about by the systematic retardation of industries for over a hundred years.

### CONCLUDING OBSERVATIONS

I have said before that large sums of money have to be invested if there is to be any real progress in manufacture or production under the head industries in this country. I have elsewhere suggested that not less than Rs. 400 crores per annum should be invested as capital in industries for the next five years of which Rs. 100 crores may be investment direct by Government. We may have to spend from current revenues on staff, equipment, subsidies, etc., at least Rs. 10 crores more every year for encouraging the birth of new industries. The experience in this field is : "You must spend well in order to earn well."

Business leaders Mr. G. D. Birla and Mr. A. D. Shroff have been suggesting the same thing namely the need of large investments if the country is to make a mark in industries. Even if Rs. 400 crores per annum are spent during the next five years, the total capital expenditure at the end of the fifth year will be not more than what Canada with a population of only 12 million has already invested in industries. Money has to be borrowed as soon as necessity is felt and America would be quite willing to supply it if satisfactory business relations are established between the two countries at the Government level. The contracting parties to the loans will be not the Governmet of either country but financial or other large firms in America which lend the money on one side and private business firms in India which use it on remunerative industries on the other.

The arrangements here indicated are similar to what America herself followed in building up her industries by borrowing money from England towards the end of the last and the commencement of the present century. Before the first World War, America in her relations with Great Britain was a debtor country. She built up her industries and ten years later became a creditor to Great Britain herself. Investment of capital will lead to increase of gross products and income. Extreme caution in borrowing and investment will leave the country weak and poor. Courage is needed. Conditions in India have been extraordinary. Having been subjected to suppression and retardation in the past, industries are no more than a wreck at the present time and they therefore are in need of strong Government sympathy and support.

With an uneducated population and its abnormally low earning power, new methods similar to those suggested by the practices of the West, are necessary for industrial rehabilitation and such necessity should be recognised by the Governments both at the Centre as well as in the Provinces. There should be no objection to borrow money, if, as is believed, it can be done in this case without political risks, and use it as capital to promote industries because the money so used is not actually spent on current needs but will be invested in industries and become real interest-yielding assets. The present emergency demands that Government should follow courageous policies and take all reasonable measures necessary to raise the working power of the people and through the working power the prosperity of the country.

## SCIENTIFIC INFORMATION SERVICES

SPEAKING at the Opening Session of the Royal Society Scientific Information Conference, called to examine the possibility of improvement in existing methods of collection, indexing and distribution of scientific literature, Sir Edward Appleton, G.B.E., K.C.B., F.R.S., Secretary of the Department of Scientific and Industrial Research said :—

"We would all agree that no scientist gives of his best in isolation. But in spite of everything we manage to do to foster the movement of scientists, and to effect personal contacts between them, we have to admit that they live chiefly on the printed word. After all, it is often by the medium of publication that a scientific worker may be helped—and indeed often inspired—by a fellow worker whom he may never have seen and who lives thousands of miles away.

Science has been well served in the past by the publications of its Learned Societies and Academies and by the scientific journals. But the spate of scientific publications is now such that it is becoming extremely difficult to keep abreast with events on even the most limited sector of the scientific frontier.

This spate of scientific publications may, I think, be illustrated in the following way. If anyone set himself the task of merely reading —let alone trying to understand—all the scientific journals published and worked solidly at his task every day for a year he would discover that at the end of the year he was already more than 10 years behind. If the same constant reader had included the technical literature as well he would find himself about 100 years behind in his work after 12 months effort.

Obviously something must be done to relieve the situation and it is the object of this Conference to find out what that something should be. The really important objectives to be achieved are three-fold. First, to ensure that the scientist gets all he needs; secondly, that he gets it quickly; and thirdly, that he gets it in the right form and shape. Any solution you recommend must, however, be practicable. It must be reasonable in cost and it must take into account the acute shortage of scientific manpower which is hampering the development of almost every scientific organisation in the world—and certainly every organisation in the British Commonwealth.

It seems to me that you will reach satisfactory solutions of the problems which are before you only if you keep constantly in mind the needs of the scientific user. And you have got to protect him from indigestion as well as to give him the sustenance he needs. You are concerned with this question of the spate of scientific literature. My library contains many a lengthening file of unread journals. The great majority of those journals will *never* be read—and still less understood—by me. Personally what I require, as a working scientist, are reprints or separates of the papers that matter to me. And I want them quickly and in a form easily storable. In choosing the reprints of the papers I require I want the guidance of brief abstracts to inform me of the existence and contents of those papers. These should be short, conveniently classified for the user, and should be available soon after the papers are printed. Scientists working in other fields may well have different needs and it may be necessary for you to engage in some form of operational research to enable you to formulate user needs more precisely. Indeed I gather that something on these lines has already been started.

Then there is the question of translations. Here is certainly a field where co-operation will lead to economy of effort. I well remember that, during the early part of the War, I discovered that a certain German paper, which had an important bearing on radar, had been independently translated by three Government Departments. It was, of course, easy to prevent that kind of thing happening again within the limited field of Government science but we want to see economy of this kind extended to all scientific information services."

## THE HON'BLE PRIME MINISTER, ORISSA, ASKS :— "CAN NOT THE SCIENTISTS RESCUE THE POOR VILLAGERS FROM THE WRATH OF FIRE?"

INDIA consists of 75,00,000 villages where people, due to poverty, live in huts. Almost all the houses in the rural and a large number even in the urban areas are thatched with straw. In the Province of Orissa except a very few all houses both in urban and rural areas are straw thatched. This year's experience shows that a very large number of houses have been burnt down in the country side of Orissa during the severe summer and in many places the fire could not be brought under control by the villagers. Loss on this account is enormous both to the people who have been deprived of their lives' savings and to the Government who have rushed relief to the stricken.

It is now high time for our Scientists to solve a problem of national importance by evolving a method for making straw fire-proof.

# AIR MASSES IN TROPICAL CYCLONIC STORMS FROM RADIO-SONDE DATA

S. L. MALURKAR AND P. R. PISHAROTY

*Poona 5*

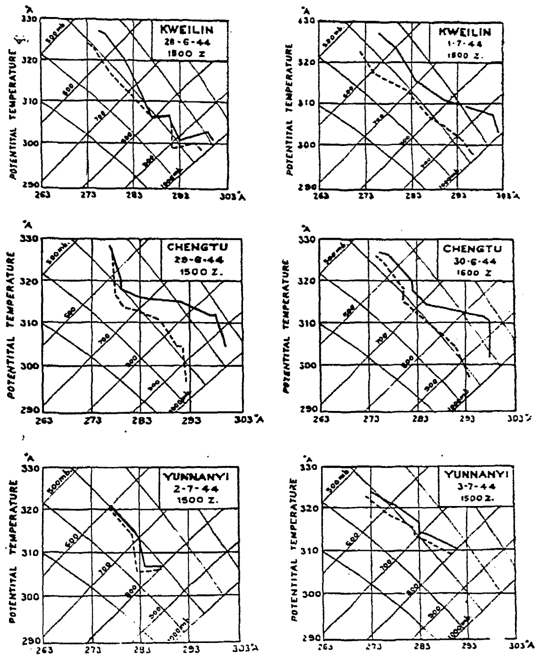
IN an attempt to study the air masses[1] in the Indian area associated with monsoon depressions or with the pre- and post-monsoon months, it was found that one has essentially to deal with three distinct air masses with separate regions of travel. The air masses entering into the structure, of all tropical cyclonic storms or depressions, could be considered as nearly the same. In the absence of one of these air masses, usually, no westward moving tropical depressions formed and only a low pressure wave resulted.

The air-masses are: (1) air from the S. hemisphere whose incursions across the equator occur at discrete intervals. The character of this air after crossing the equator remains sensibly the same (Fm); (2) air from the Far East ultimately the N. Pacific high which forms part of the 'N. E. Trades', its character is essentially stable but the temperature and humidity depend on the season and region of travel, and (3) dry continental air, with its large diurnal variation of temperature, from regions to the west of the depression. The properties of the air masses are described elsewhere.[2]

The tracing of the far eastern air as a distinct one was not easy. The observations, from regions east of India, were not available. Even in pre-war days, the area from S. China to Upper Burma was not meteorologically well represented. In the Pacific Ocean, the data were still less. Only, Deppermann[3] had tackled the question of air masses near the Philippines. The isobaric configuration in N. E. India, the weather sequence before the onset of a monsoon depression and the nature of precipitation showed that an air mass distinct from that of fresh monsoon air and also from dry continental air was involved. During the year 1944, radio-sonde ascents were made at a number of stations in India and the neighbouring countries like S. China.

With the close of the war, the radio-sonde stations, which were mostly maintained by the army air force of the U. S. A. in places bordering to the east of India were closed down. The detection of the far eastern air, with only data from inside India, would again present difficulties, if the experience gathered during the war period was not utilised and recorded.

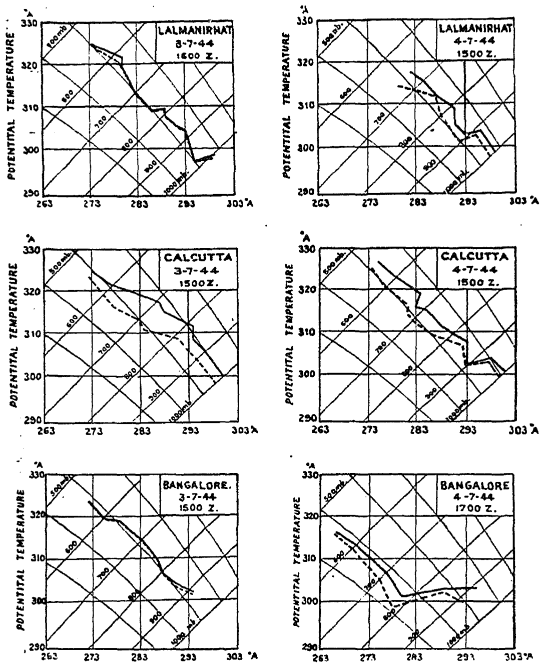
*Technique.*—The radio-sonde data are recent in and near India.[4] In the temperate latitudes where the temperature and humidity change considerably with different air masses, the small instrumental defects can be ignored. But in the tropics, the temperature changes associated with different air masses near a depression are small. One is apt to ignore altogether the significance of small changes as being below the limit of instrumental errors. If one depended solely on the upper air temperature and humidity data, it may be the correct attitude. When the data are used along with synoptic charts, their utility cannot be challenged. The incursion of fresh air masses can be checked up alternately from surface and upper air data. When all the T - Ø grams are studied, the shape of the curves indicates the incursion of fresh air masses. The fall or rise in temperature at higher levels, if shown in a sequence at a number of stations far away from one another or if shown simultaneously at nearby stations can be relied upon and should not be ignored.




The deductions in this paper were confirmed in every instance when there was a tropical depression and upper air temperatures available. Only one typical example of a monsoon depression and one typical tropical cyclonic storm are cited here. The examples have already been looked into from the surface indications to minimise space. Only the very essential diagrams are given. The diagrams for days immediately preceding and succeeding days are only described. For the same reason, the question of tracing of the continental air, which can be done even on surface charts has not been stressed.

*Observations:* Based on the westward passage of a shallow low pressure area south of the equator and the rise of pressure at Mauritius in the preceding 24 hrs., a forecast for a week-ahead was issued on July 3rd, 1944, that the monsoon may strengthen in the Indian area during the latter half of the week. It was expected that a 'pulse' of fresh monsoon air was about to cross the equator and form a depression at the head of the Bay of Bengal

after three or four days. The Bay depression formed on 7th July 1944. Pisharoty[5] has cited the T - Ø grams of Bangalore for 4th and 5th July and shown that an 'unstable' or more accurately a less stable than usual air passed over the place; and that similar less stable air masses passed over Bangalore before the formation of other monsoon depressions, at the head of the Bay of Bengal. In the following $\theta_w$ is used as wet bulb potential temperature in the absolute scale of degrees, and only the numerals are put in.




Main features of the diagrams are only given.

*Bangalore*

*3rd July 1944.* Between 900 and 840 mbs. $\theta_w$ was greater than 296, while it was just 296 between 840 and 800 mbs. It was again greater than 296 between 800 and 630 mbs., and it was 295·5 between 600 and 525 mbs. The curve was almost dry adiabatic between 630 and 600 mbs.

*4th July.* The curve was super-adiabatic between 900 and 780 mbs. $\theta_w$ falling from nearly 298 at the surface to 290 at the higher level. $\theta_w$ was between 291·5 and 290 from 780 to 525 mbs.

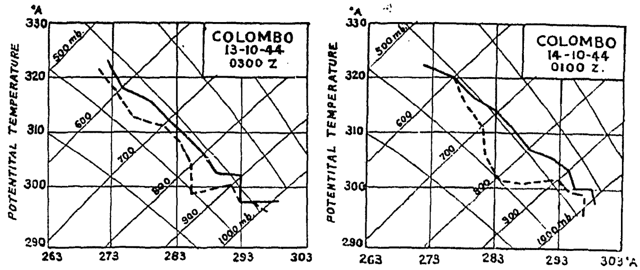
*5th July.* From 900 to 650 mbs., the curve is almost a straight line, $\theta_w$ being 297 and 291·5 at the extreme levels: At heights above 650 mbs. $\theta_w$ was greater than 291·5

*6th July.* No ascent.

*7th July.* $\theta_w$ was everywhere greater than 295 and often greater than 296.

The drop in the wet bulb potential temperature showed that there was an incursion of fresh air over Bangalore on 4th July 1944 (cf. Pisharoty, *loc. cit.*). The air was not quite stable. It could easily give rise to or maintain thunderstorms. The only source of colder air at the top could be from the southern hemisphere where it was winter.

The data for the Far Eastern Transitional or Mixed air (Tr) are derived from Kweilin (110° 10′ E, 25° 15′ N.), Chengtu (104° 02′ E, 30° 15′ N.), Yunannyi (100° 44′ E, 25° 25′ N), Lalmanirhat (Assam) and Calcutta.



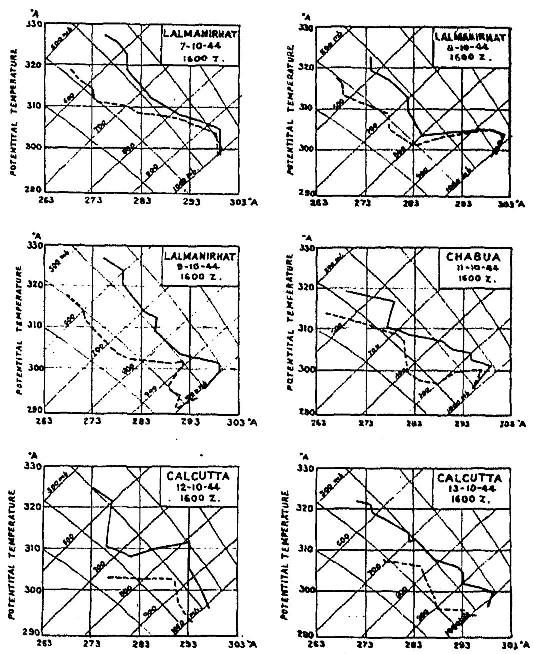

*Kweilin :*

*28th June 1944.* The curve is slightly superadiabatic from 950 to 920 mbs. and almost dry adiabatic from 840 to 800 mbs. $\theta_w$ was less than 298 at all heights above 930 mbs.

*29th and 30th June.* No ascents.

*1st July.* $\theta_w$ was above 298 upto about 780 mbs.

*2nd July.* Nothing special to report.




*Chengtu*

*29th June 1944.* Dry adiabatic between 850 and 650 mbs. showing a fresh incursion of air over the place.

*30th June.* The fresh incursion of air persisted.

*Yunannyi*

*1st July 1944.* "Normal curve." $\theta_w$ almost 297·5.

*2nd July.* Short flight; between 800 and 750 mbs.—dry adiabatic and higher up the temperatures had fallen since previous day and $\theta_w$ was there 296.

*3rd July.* Temperatures had increased upto 700 mbs. Lapse-rates were between dry and wet adiabatic values.

*4th July.* "Normal curve"—all temperatures had increased.

*Lalmanirhat*

*3rd July 1944.* Almost super-adiabatic lapse-rate from ground to 970 mbs. Nothing else of importance.

*4th July.* Temperatures had fallen from the previous day from 920 to 820 mbs. $\theta_w$ was 299 upto 910 mbs. and below 298 at heights above that level.

*5th and 6th July.* No ascents.

*7th July.* $\theta_w$ touched 302 at the height corresponding to 960 mbs. and was above 298 at all heights upto 580 mbs.

*Calcutta*

*3rd July 1944.* The curve nearly saturated upto 780 mbs. $\theta_w$ was 300.

*4th July.* From 940 to 840 mbs., a wedge of cold air had come in and above 840 mbs., $\theta_w$ did not exceed 298·5.

*5th July.* No ascent.

*6th July.* "Normal curve."

There is an unmistakable incursion of a fresh air mass from Kweilin on 28th June 1944 to Chengtu on the 29th, to Yunannyi on 2nd July and to Assam and Bengal on the 4th July. At Lalmanirhat and Calcutta, the thickness of the layer is almost the same and occurs at the same height intervals. *The air is not dry nor unstable.* By the time the air reaches Bengal, it is more moist and hotter than Em, as shown by a comparison of $\theta_w$ over Calcutta and Bangalore, being 300 and 290 respectively.

The surface charts, earlier than 7th July, show distinctly the incursion of fresh dry continental air into the Bay.

The Far Eastern air, that came over Calcutta and Lalmanirhat on the *same day* as Em over Bangalore, shows a definitely higher temperature and has to be treated as a distinct mass from the east and not as part of an 'old monsoon' stream. The Far Eastern Transitional air (Tr) passes over the neighbourhood of the thermal equator and over regions which are fully saturated due to swamps and forests in the track from Indo-China to Burma. The air is hotter and very much more oppressive than Em. Deppermann also noticed the hot air to the northeast of the Philippine typhoons, but did not follow it very much.

During the middle of October 1944, a tropical cyclonic storm formed in the Bay of Bengal. Between the 12th and 13th October 44 a 'pulse' of fresh monsoon air crossed to the north of the equator.[6] From the radio-sonde ascents, it is seen below that a fresh air mass passed over Colombo on the 13th.

*Colombo*

*12th Oct. 1944.* $\theta_w$ was more than 296 upto 640 mbs. The curve was dry adiabatic from 850 to 760 mbs.

*13th Oct.* From ground to 940 mbs.; the lapse-rate was dry adiabatic and also again from 900 to 850 mbs. Above 850 mbs. $\theta_w$ was 295.

*14th Oct.* Temperature curve almost normal. $\theta_w$ was greater than 296 upto 670 mbs.

The radio-sonde ascent of 6th Oct. shows a distinct colder wedge of air between 700 and 550 mbs. In the next available ascent on 10th, there is no such wedge.

*Lalmanirhat*

*7th Oct. 1944.* Curve normal.

*8th Oct.* From 940 to 800 mbs.—slight superadiabatic lapserate. All temperatures less than on the previous day.

*9th Oct.* Colder wedge from 900 to 600 mbs. can still be seen; though the shape of temperature curve has recovered.

*10th and 11th Oct.* Fresh incursions of air.

After that date for a few days, the curves were normal.

*Calcutta*

*12th Oct. 1944.* A remarkable wedge of cold air between 800 and 600 mbs. The air is not moist though not very dry.

*13th Oct.* The temperature curve had recovered.

The fresh air mass that was over Chengtu about the 6th of Oct. 1944 passed over Calcutta on the 12th to feed the Bay depression; while the fresh 'pulse' passed over Colombo on the 13th. The fresh air mass from the east is not very moist in this season. Data from an earlier epoch than the depression have to be examined as Tr may have to travel longer in case of tropical cyclonic storms.

The data of Chittagong and Chabua (Assam) generally support the incursion of fresh air mass for the above cyclonic storm. Chabua shows layers of subsidence from 675 to 640 mbs. and again from 550 to 515 mbs. on the 11th. This disappeared on the next day.

The dry continental air gave a sharp wedge on 5th Oct. 44 extending from Russian Turkestan to Mekran and brought in unusually low temperatures over N. W. India. The low temperatures gradually extended throughout N. India during the course of the succeeding week and descended down the latitudes to feed the depression in the Bay of Bengal.[7]

It follows that the upper air temperatures confirm the conclusion that three distinct air masses are involved in the tropical cyclonic storms and in the monsoon depressions. Elsewhere,[8] it has been pointed out that the easterly upper wind stream should not be looked for just north of the place where ultimately a depression forms but should be noticed very much further north, just as in the case of the extra-tropical cyclones.

---

1. Malurkar, "Forecasting Weather in and near India," 1945 (limited ed.), p. 42, and p. 87. 2. Malurkar, *Curr. Sci.*, 1948, **17**, 112. 3. Deppermann, 'Outlines of Philippine Frontology.' 'Are there Warm Sectors in Philippine Typhoons,' 1937. Weather Bureau, Manila. 4. Data printed in Indian Daily Weather Reports. 5. Pisharoty, "Combined Role of Fresh Monsoon 'pulses' and Easterly Waves in the Formation of Monsoon Storms", *Symp. Nat. Inst. Sci. (India)*, Aug. Sept., 1946. 6. Malurkar, "Forecasting Weather, etc.," *loc. cit.* 7. *Ibid.*, 8. Malurkar, 'Role of three air masses in Tropical Cyclonic Storms' at present MSS.

*Note.*—The cost of printing this article has been met from a generous grant from the National Institute of Sciences, India.

# LETTERS TO THE EDITOR



## ON THE FLAME SPECTRUM OF CuCl

The purpose of this note is to report the observation of some new bands of CuCl which have been found while studying the flame spectrum of this salt with quite a different objective.

The spectrum of CuCl is rather easily excited in the flame and has been studied by a number of workers. The more recent work is due to Ritschl[1] who has measured a large number of bands between λ 5506 and λ 3997 A. These bands have been arranged into 5 different systems, usually denoted as systems A, B, C, D and E with their 0,0 bands at λ 5262, λ 4882, λ 4847, λ 4354 and λ 4333 A, respectively.

In course of the present investigation of the flame spectrum of CuCl, bands have been observed to as low wavelengths as λ 3500 A. The CuCl flame was obtained by burning asbestos thread, wound over an iron ring and soaked into the solution of the salt in water, over a Bunsen burner. A specially built large aperture quartz spectrograph, with dispersion nearly the same as that of the small quartz spectrograph supplied by Adam and Hilger, was used to photograph the bands. Besides the CuCl bands in the regions noted by other workers, some more bands were observed at lower wavelengths. Their measurements are given in the table below, and since the dispersion employed was very low, they will be correct only upto ± 3 A. The reason why they were not previously observed is probably that the spectrographs used were not fast enough to record these faint bands.

TABLE I

*Some additional CuCl bands in flame*

| $\lambda_{air}$ (A.) | $\nu_{vac.}$ (cm.$^{-1}$) | $v'$, $v''$ | $\nu_{vac.}$ (calc.) | $\lambda_{air}$ (A)[2] |
|---|---|---|---|---|
| 4005 | 24960 | 8, 3 | 24963 | 4010 |
| 3950 | 25310 | 9, 3 | 25325 | 3945 |
| 3890 | 25700 | 10, 3 | 25694 | 3885 |
| 3835 | 26070 | 11, 3 | 26061 | 3835 |
| 3785 | 26415 | 12, 3 | 26420 | 3785 |
| 3735 | 26770 | 13, 3 | 26780 | |
| 3685 | 27130 | 14, 3 | 26136 | |
| 3570 | 28005 | | | |
| 3490 | 28645 | | | |

It is difficult to say whether the new bands belong to one of the old systems or they form a new system by themselves. They are, however, found to fit in quite well with system E of Ritschl, and a tentative assignment of their vibrational quantum number is also given in the table. They seem to represent the heads of the sequences $\Delta v = 5$ to 11. Other members of the sequences could not probably be resolved at this low dispersion. Column 4 of the table gives $\nu_{vac.}$ for the calculated positions of these bands

and in view of the low dispersion employed, the agreement does not seem unsatisfactory. Lord Rayleigh and Fowler[2] who studied the spectrum of this salt excited by active nitrogen, also observed a few bands in this region; their measurements are given in the last column of the table.

Science College, Patna,
*May* 29, 1948. S. P. SINHA.

1. Ritschl, R., *Z. Phys.*, 1927, **42**, 172. 2. Lord Rayleigh and Fowler, A., *Proc. Roy. Soc.*, **A**, 1911, **86**, 105.

## SQUARES OF NUMBERS

IN the June 1947 issue of the *Current Science* (Vol. **16**, No. 6, pp. 178–79) Azizuddin Ahmad Siddiqi addressed a letter to the Editor explaining "A New Method of Obtaining Squares of Numbers". Though there is nothing very much new in the method, it simply seems to have been an attempt at popularising its use as "*a simple and ready method*" It may, however, interest your readers to know that the method sponsored is only a special case of the gereral rule for the multiplication of any two numbers, and that even the general rule itself can be presented in a much simpler manner. This is best illustrated by an actual numerical example below: Suppose two numbers 2,734,681 and 64,537 are to be multiplied. There are 7 digits in one and 5 in the other. In order that they may have equal digits add two zeros to the left of 6 in the second number and write them down one below the other as under:

```
X=   2734681
Y=   0064537
     -------
           7......first row
          59
         71
        90
      101
     150
    102
    77
   56
  50
 12
-------------
Z= 176488107697
```

The process begins with the multiplication of the two units place digits in the two numbers X and Y. Put this result down below in the first row. Cross-multiply the units and tenths place digits in X and Y and put down their sum one place to the left in the second row. Next cross-multiply the units, tenths, and hundredths place digits in X and Y and similarly put down the sum of the three sub-products two places to the left in the third row, and so on. The continued process of further cross-multiplication and summation is self-explanatory. In all, there will be $p+q-1$ rows obtained from the original number of $p$ digits in X and $q$ digits in Y. When this process is complete, add up the digits in the units places in the several rows to obtain the units places digit in the final product number Z, and so on for all the other place digits with the system of carry-over being observed. The result Z will be the final product required.

It is easy to explain the method described above in the language of algebra as below. Remembering that any positive integral number having $k+1$ digits can always be expressed in a series form as

$$a_0+10a_1+10^2a_2+10^3a_3+\dots\dots+10^k a_k$$

the product of two such series

$$a_0+10a_1+10^2a_2+10^3a_3+\dots\dots+10^k a_k$$
$$x_0+10x_1+10^2x_2+10^3x_3+\dots\dots+10^m x_m,$$

where $m\leqslant k$ has been obtained in all standard text-books on algebra as

$$\begin{aligned}&a_0x_0+10\,(a_0x_1+a_1x_0)+\\&\quad 10^2(a_0x_2+a_1x_1+a_2x_0)+\dots\dots\\&\quad +10^m\,(a_0x_m+a_1x_{m-1}+\dots\dots+a_mx_0)+\dots\\&\quad +10^{m+r}\,(a_rx_m+a_{r+1}\,x_{m-1}+\dots+a_kx_{m+r-k})\\&\quad +\dots\dots+10^{m+k}a_kx_m\end{aligned}$$

where $r$ assumes all positive integral values up to $r=k$. The reason for placing the various sums in the different rows in the illustrative example above in the manner explained is at once obvious from the last algebraic expression obtained for the product of two numbers.

Statistics Branch, C.W.I.N.C., New Delhi,
*April* 23, 1948.
G. M. PANCHANG.
R. V. VISWANATHAN.

## MANGANESE CHLORIDE EMISSION BANDS

EXCITING the vapour of manganese chloride in a heavy current discharge from a 2,000 volt D. C. Generator through a continuously evacuated quartz tube with hollow cylindrical electrodes, a characteristic band system attributed to the diatomic molecule MnCl is obtained between λ3900–λ3500 consisting of seven well-separated marked close sequences of violet degraded bands. The bands have, in part, a line-like appearance and have subsidiary components, besides the chlorine isotopic heads. Pearse and Gaydon[1] have made a brief mention of bands ascribed to this molecule by Mesnage from a study of High Frequency discharge through MnCl. Only the first members of three sequences are reported. A much more extensive system has been obtained by the author and the vibrational analysis has led to the following constants, $\omega_e'=412\cdot0$ and $\omega_e''=384\cdot1$, the anharmonic constants being very small. The chlorine isotopic shifts completely support the analysis. Details will be published elsewhere.

Andhra University, Waltair,
*June* 25, 1948.
P. TIRUVENGANNA RAO.

1. Pearse and Gaydon, "Identification of Molecular Spectra," 1941, 136.

## MESON TRACKS ON PLATES EXPOSED ON THE NILGIRIS

THIS note gives the results of measurements on cosmic ray tracks obtained on photographic plates, which were exposed in the open on the Niligiris in South India during Nov.-Dec. 1947. A set of Ilford nuclear research, type B 1,100 $\mu$ thickness emulsion plates, contained in a paraffin-covered cardboard box was exposed for six weeks at Ootacamund (altitude 7,300 feet) and a similar set contained in a thin wall aluminium case was exposed, during the same period, at Aruvankadu (altitude 6,700 feet). A Zeiss microscope fitted with a 44 X objective and a 10 X micrometer scale eyepiece, was used for the measurements of the tracks on the plates. The average number of meson tracks as identified by their characteristic low grain density, large angle of scattering and thick grain density towards end of range, are found to be 0·52 and 0.47 per sq. cm., on the plates exposed at Ootacamund and Aruvankadu, respectively. The track lengths are found to vary from 100 to 800$\mu$, with the majority of them around 150$\mu$. The lower limit for the number of mesons that arrive per day per c.c., therefore, at the altitnde 7000 feet and geomagnetic latitude 2·8° will be 0.7. Of the 32 tracks examined, only two, whose lengths are 570$\mu$ and 590$\mu$, seem to correspond to the $\mu$-decay meson observed in the photographs of Lattes and co-workers.[1]

We thank Messrs. S. Ramachandra Rao of Ootacamund and K. Doraiswami of Aruvankadu for assistance in exposing the plates on the Niligiris.

Central College, Bangalore,
*July* 8, 1948.

S. BALAKRISHNA RAO.
C. K. SUNDARACHAR.

1. C. M. G. Lattes, *et al.*, *Nature.*, 1947, **160**, 485.

## ROLE OF THREE AIR MASSES IN TROPICAL CYCLONIC STORMS

A CYCLONIC storm is strictly "tropical" when three air masses Em, Tr and Tc or Tcm enter into its formative structure and when it has a westward tendency of motion.[1] The properties of air masses have been described elsewhere.[2] There is considerable divergence regarding the need and the role of the air masses: whether the release of latent heat of moisture or whether the waves set up at the interface of two necessary air streams as in the extratropical latitudes give rise to a tropical cyclonic storm. In the lower latitudes, the component of earth's angular velocity is small. An approach to the problem should tackle both the production or release of energy and the cyclonic vorticity. I have pointed out earlier that Em, the equatorial maritime air, acts as the thermodynamic 'source', that Tc or Tcm, the tropical continental air or the tropical continental maritime air, acts as a 'sink' and that Tr, the far eastern transitional or mixed air, is required to delay the cycle of operations till sufficient cyclonic vorticity is developed.[3] In the tropics, cyclonic vorticity and release of energy are two distinct entities and may not necessarily co-exist.[4] A closed low pressure area is characterised by a vertical structure with an almost dry adiabatic lapse-rate over several kilometres and over a short height with even super-adiabatic lapse-rate. The situation is such that it is favourable for maintenance of convection.

It has been known for a long time, though it has had to be re-stressed at intervals, that the southerly air, which has its origin in the 'S. E. Trades' in the southern hemisphere, was a necessary concomitant of the weather over a large part of the Indian area during and near about the northern summer. As the theory of cyclonic storms is to be the same everywhere in the tropics, it is sufficient to deal with conditions in the north Indian Ocean. For the release of energy of monsoon depressions and tropical cyclonic storms, Em is needed. An examination of the vertical structure of temperature and humidity of Em shows that it can easily release energy. Em has to be the 'source' for the release of energy.

For the major period that tropical cyclonic storms or monsoon depressions form in the Indian area Tr is hotter and in the lower layers mostly more moist than Em. Both the dry and wet bulb potential temperatures of Tr are greater than that for Em. This warm or hot easterly air has not been found to behave analogous to the air of the 'warm sector' of an extra-tropical depression by Deppermann[5] and others. The precipitation occurs from lower heights than 12,000 ft. There is also a marked temperature inversion in the 'Trades' between 1·5 and 2·0 km. Hence Tr cannot be considered as a 'source' and certainly not as a 'sink' of a tropical cyclonic storm.

The continental air is dry, often very dry. For depressions that form in the Bay of Bengal, the movement of Tc can easily be followed by the temperature waves from beyond the N. W. frontier of India (geographical).[6] Here the potential wet bulb temperature of the air is considerably below that of either Tr or Em. This air has some sea travel, for depressions that form in the east Bay of Bengal or east Arabian Sea. But this sea travel of Tc is much smaller than that for Tr. Hence Tc or Tcm can play the role of 'sink'.

In the temperate latitudes, the westerly winds are to the equatorial side of the easterlies. This juxtaposition gives rise to a 'natural' cyclonic vorticity. In the tropics, in the non-monsoon months, and during breaks of the monsoon, the strength of the westerlies generally decreases on approaching the equator. In the monsoon months, Tc has a westerly component and Em has a westerly and occasionally an easterly component. In the absence of an easterly Tr north of Em; the natural vorticity, in the tropics, that one can expect is anticyclonic. To overcome the latter and induce a cyclonic vorticity, one or both of the following should happen: the westerly component of Em should be increased and the westerly strength of Tc should be decreased, so that the westerly component of the wind may decrease with increase of latitude. With the passage of a monsoon 'pulse' or Em across the equator from the southern hemisphere to

the Bay of Bengal; the winds at Mannar, Trincomalee, Trichinopoly and often at Colombo reach gale force below 2 km. The corresponding wind force before the passage of Em would be light to moderate. The second condition is satisfied if an easterly stream due to Tr is superposed on the field of Tc. If there be a sufficient supply of Tr, the juxtaposition would show a cyclonic vorticity in the neld. If at the interface of Em and Tr, unstable perturbations are set up, the conditions would lead to the formation of a tropical cyclonic storm. The fact that there is considerable difference in the properties of Em and Tr need not complicate the issue except to demarcate the streams. The release of energy must be due to Em and Tc or Tcm. It is difficult to assess which two streams of the three must first come into play. In the description of tropical cyclonic storms[7] all the instances that occurred over two years have been taken into account, and an examination was made of cyclonic storms for a period of nearly ten years. The facts were consistent with the assumption of the air masses above.

It has been argued as a serious objection to the above picture that, in the formative stage, there was no easterly component of wind to the north or northeast of the centre of the tropical cyclonic storm. Dr. Sverre Petterssen showed, in his talk on Feb. 11th, 1948, at the Poona Meteorological Office, that if a cyclonic vorticity is induced due to the shear at the partition of Em and Tr in the north tropics, the resulting depression would form to the southeast of the area enclosed earlier by the two streams. It appears necessary to look for the easterlies in the formative stage of a tropical cyclonic storm much further north than the subsequent centre of the storm. In other words, a tropical cyclonic storm forms to the southeast of the triangular area formed by the three streams Em, Tr and Tc or Tcm and not inside it. This clears up a number of small but essential difficulties.

It is often noticed that a small low pressure area travels westwards across Assam and north Bengal showing the passage of a residual of a China Sea typhoon. But the resulting monsoon depression forms often in the north angle of the Bay of Bengal and gives an apparent southward travel to the residual of the typhoon. The incursion of Tr is shown by the westward passage of shallow low pressure areas.[4] The low pressure area over Assam and north Bengal may not necessarily be due to the actual westward passage of the China Sea typhoon but may just indicate the incursion of Tr. The formation of the monsoon depression much further south of Tr becomes understandable from last para.

The passage of Em across the equator is discontinuous and occurs only at intervals. As Em moves north to form a tropical cyclonic storm, it does not form a continuation of the S.E. Trades on the other side of the equator. Between Em and the equator the mixed air Tr and Tc can and does flow. This allows the passage of northern Tr to the south to form the Em of the southern tropical cyclonic storm that often forms in a more easterly longitude. The invasion of Tr, south of the tropical cyclonic storm and the equator, also allows the infeed of Tr to a secondary tropical cyclonic storm in the same hemisphere forming in a more westerly longitude. The secondary tropical cyclonic storm must form to the south of Tr. The secondary tropical cyclonic storm in the same hemisphere and in a more westerly longitude, would be therefore much further south than what one would have expected from only elementary considerations. This fact is amply borne out by the tropical cyclonic storms that form in the Bay of Bengal which can be considered as secondaries of China Sea typhoons. Due to paucity of observations, it may happen that the primary and secondary tropical cyclonic storms get mixed up and the tropical cyclonic storm is given a large southerly direction and movement.

Poona 5, S. L. MALURKAR.
*February* 12, 1948.

1. Malurkar, *Curr. Sci.*, 1947, **16**, 277. 2. *Ibid.*, 1947, 174 and "Recent Advances in Tropical Meteorology", *Ind. Sci. Congress Symposium*, Jan. 1948. 3. Malurkar., *Curr. Sci.*, 1947, **16**, 14. 4. Malurkar, *Proc. Ind. Acad. Sci.* (Bangalore), 1947, **25**, 297. 5. Deppermann, "Are there warm sectors in Philippine Typhoon" Weather Bureau, Manila, 1936. 6. Malurkar, *Forecasting Weather In or Near India*, 1945, **43**, 90. 7. *Ibid.*, 63.

## A NOTE ON THE PETROLOGY OF THE CORUNDUM AND CHROMITE-BEARING ROCKS OF THE SITHAMPUNDI-RAMADEVAM AREA, NAMAKKAL TALUK, SALEM DISTRICT, MADRAS

DURING the re-examination of the Sithampundi corundum belt, a hitherto unrecorded occurrence of chromite ore was located. The results of a preliminary examination of the rocks of this area are outlined below:—

Anorthite-hornblende gneisses form an arc shaped belt, with a southerly convexity, and run for a length of nearly fifteen miles, from Pattalur in the west to Kottakkalpalaiyam in the east. The general trend of these gneisses is W.N.W. in the west gradually veering to E.N.E. towards the eastern end and maintaining an uniform southerly dip. The chromite-bearing amphibolites and the associated pyroxenites and pyroxene-garnet rocks occur interbanded along the foliation planes of the anorthite-hornblende gneiss. Several bands of chromite-bearing amphibolites of varying thickness traverse practically the whole of the anorthite gneiss belt.

The anorthite-hornblende gneiss is an even grained pale coloured rock, essentially made up of basic feldspars and greenish black amphiboles, the latter arranged with their longer axis parallel to the general direction of foliation. Textural, as well as mineralogical variants of the main type are met with, some varieties being salic, wherein the development of minerals like chondrodite, zoisite, scapolite and garnet is marked. The corundum for which these rocks are quarried occurs sparsely distri-

buted in the rock and is generally surrounded by a shell of calcite, and is of a pale green colour. But a pink variety of the mineral occurs along the intrusive contacts of the anorthite gneiss and chromite-amphibolite. It is probable that the two varieties of the mineral are of diverse origin.

In thin section the rock is equi-granular and made up of a groundmass of broken up basic feldspars. These have been described as 'Indianite' (anorthite) by Count de Bournon. Determinations of the An content of a few pieces of the mineral on the Fedorov universal stage however, show them to range in composition from An = 55% to 100%. The pieces examined displayed twinning of the ALA, MANEBACH, and MANEBACH-ALA types. Variation in the An content of adjacent lamellæ to the order of 18% is a feature recorded in some of the pieces examined. The amphibole noticed in these rocks is of a pale green variety with the following optical characters :—

X = yellow green, Y pale green, Z grass green, $2V = -80^\circ \pm 4$, $C \wedge Z = 13^\circ \pm 2$, conforming to those of Actinolite. Other minerals noticed in micro-sections of these rocks are, chondrodite, garnet, apatite, corundum, scapolite and clinozoisite (Fouqueite) with $2V = +88^\circ$.

The chromite bearing amphibolite is a beautiful green rock made up of acicular needles of green hornblende, and grains and stringers of chromite, while grains of pink corundum are noticed in the rocks along the contact zone. Experiments on the electromagnetic concentration of this rock show the maximum chromite content to be about 55 per cent.

In thin sections the rock is made up of an aggregate of green pleochroic amphibole with the following optical characters :—

X = green, Y = yellowish green, Z = bluish green, $2V = \pm 78^\circ \pm 4$, $C \wedge Z = 23^\circ \pm 3$ (or even $30^\circ$). It is probably a variety of pargasite. In some of the microsections a non-pleochroic bladed amphibole displaying straight extinction was noticed. The optic axial angle was found to be $2V = -84^\circ$, indicating it to be the rhombic amphibole gedrite. The fine play of colours exhibited by the mineral in hand specimens may be attributed to the presence of microscopic inclusions. Other minerals observed are zoisite, corundum, picotite, secondary chlorite and talc.

The garnetiferous pyroxenite is made up of a groundmass of diopsidic pyroxene ($2V = +56^\circ$) in which are embedded crystals of pale yellow garnet which show alteration to kelyphite and chlorite. The rock is devoid of feldspars. The pyroxenite is an aggregate of clino and orthopyroxenes, the former has the following optical constants, ($2V = +48^\circ$; $C \wedge Z = 40^\circ$), while the latter is pleochroic hypersthene.

*Origin of Corundum.*—As already referred to, the pale green corundum in these rocks is generally covered by a shell of calcite. This is suggestive of the splitting of anorthite by the action of $CO_2$, produced during the intrusive period, and the consequent formation of $Al_2O_3$ and calcium carbonate ($CaO\ Al_2O_3\ 2SiO_2 + CO_2 = CaCO_3 + Al_2O_3 + 2SiO_2$). The possibility of such action is supported by the presence of veins of calcite and quartzin the area.

The corundum in the amphibole rock may be due merely to an excess of alumina in the original basic intrusive, probably a pyroxenite. Its abundance in the zone of contact with the anorthite-corundum gneiss may be attributed to concentration during intrusion possibly aided by chemical changes resulting in the production of free alumina.

Our grateful thanks are due to Dr. M. S. Krishnan for his valuable suggestions in the preparation of this note.

Madras, N. K. N. AIYENGAR.
*May* 24, 1948. A. P. SUBRAMANIAM.

## VERMICULITE IN MYSORE

WHILE engaged in the mineral survey of the Pavagada taluk, Tumkur District, a yellowish-brown micaceous mineral with a bronzy lustre was noticed lying scattered in the neighbourhood of pits from which corundum had been taken out. The mineral swelled enormously when heated, more than ten times its original volume and turned fluffy and silvery grey in the process. This property of expansion by exfoliation with a worm-like movement is characteristic of vermiculite and it was therefore considered that the brittle mica was no other than vermiculite possessing its characteristic property. Subsequently, similar brittle mica, but of different shades of colour, was met with in some of the altered ultrabasic rocks near Koratagere and Nidavanda in the Tumkur District. These also possessed the property of expansion by exfoliation. Whether at any of these places vermiculite is found in abundance and in quantities capable of being commercially exploited remains yet to be investigated.

Vermiculite is one of the few minerals which till recently had remained obscure and known only as an alteration product chiefly of the micas. It is only recently that it has come to be of importance as the mineral which has revolutionized building construction. Vermiculite which when expanded weighs only 6 to 8 lbs. per cu. ft. as compared to sand which weighs 100 lbs. is used as a substitute for sand or gravel in plaster and concrete to save weight. Vermiculite plaster is said to be fire proof and sound proof, and on account of that is extensively used in the construction of radio studios, theatres, libraries, etc. It is used in making panels for prefabricated houses. Many new uses of vermiculite are being found and the demand for vermiculite is daily increasing. The important deposits of vermiculite are in Montana and North Carolina, U.S.A., and new mines are being developed in the Transvaal, South Africa.

The object of the present note is merely to draw the attention of investigators in the field to the possibilities of finding commercially important deposits of vermiculite in our country especially in areas which show lenses of basic and ultrabasic rocks in the Gneisses. The extent of the now known occurrences of vermiculite in the Tumkur District is being investigated and the results of the investigations will be published elsewhere.

B. P. RADHAKRISHNA.
Mysore Geological Department,
*June* 16, 1948.

## WATER-MELON (*CITRULLUS VULGARIS* SCHRAD.) AND FOOD-POISONING

UNLIKE in the other countries, notably U.S.A and U. K., the problem of food-poisoning in India has received little attention so much so a large number of instances occur even without our ever recognizing them. That the food-poisoning may occur in the least suspected source as fresh grapes has been pointed out earlier [2]. On May 6, 1948.[3] "*The Times of India*". reported that eight persons who ate a water-melon were removed to the hospital for treatment of food-poisoning, and added that one of them succumbed to the infection. It was of interest to examine if water-melon could serve as a suitable medium for the growth and distribution of at least the common organisms responsible for food-poisoning.

Bharucha and Bharucha[1] have already studied water-melon in connection with *V. choleræ*. We have now tested the suitability of water-melon juice as a medium for the growth of typhoid and paratyphoid group of bacteria. Water-melon juice was obtained by cutting open triangular pieces from the scrupulously cleansed and sterilized (alcohol) surface portions of the fruits specially selected for the purpose. It was possible to collect sterile juice (as tested by inoculation on MacConkey's agar only) necessary for the experiment by this procedure. The juice collected from each fruit was distributed in 10 *ml* quantities in sterile tubes and inoculated with 0·1 *ml* of thin culture-suspensions (made in sailne and matching approximately to Opacity Tube No. 1) of surface-grown agar cultures (24-hrs. old) of *E. typhosa* (Watson V. strain N.C.T.C. 5761), *S. paratyphi* (N.C.T.C. 5702), *S. schottmuelleri* (N.C.T.C. 5705), *S. enteritidis* (N.C.T.C. 5765), and *E. coli communis* (N.C.T.C. 415). The tubes were then incubated at the room temperature (30-31° C.) after 0·01 *ml* portions from each tube were removed for the quantitative estimations of the bacteria seeded in them. Further 0·01 *ml* aliquots removed from each tube at the end of 3-hrs., 6-hrs., and 24-hrs. were also, after suitable dilutions, employed for the enumeration of the bacteria. In all the cases plates of MacConkey's agar were utilized and the colonies developing on them were counted after incubation for 24-hrs. at 37° C. In every experiment the pH of the juice was also determined. The following table gives the results obtained from a few typical experiments.

The results show that all the tested bacteria grow well in the juice upto the period to which the test lasted. The growths of the *Salmonella* species representing the food-poisoning group (Para B and the enteritis strains) were particularly heavy. The juice samples inoculated with these two bacteria began to give rise to small but visible bubbles of gas within even 2-4 hours after incubation, and the turbidity produced by them in the juice after 24-hrs. growth was of the magnitude of Opacity Tube No. 3 or even No. 4. Moreover these two bacteria indicated some conspicuous cultural changes not exhibited by the other test bacteria. These changes, however, remain to be studied in detail. Another important feature in these findings is the influence of the initial pH of the juice on the multiplication of the bacteria and which is evident from the figures above. In conclusion, it may be said that water-melon, if and when contaminated, affords an excellent substratum for the growth of the intestinal bacteria, specially the organisms of the food-poisoning group; it is not therefore surprising that this fruit is known to be associated with outbreaks of food-poisoning.

| Expt. | pH | Species | Colony counts per *ml* of the juice: Initial | 3 hrs. | 6 hrs. | 24 hrs. |
|---|---|---|---|---|---|---|
| | | | $\times 10^3$ | $\times 10^3$ | $\times 10^4$ | $\times 10^5$ |
| 1 | 5·6 | T | 95 | 112 | 25·7 | 26 |
| | | A | 108 | 156 | 31·1 | 11·2 |
| | | B | 168 | 401 | 605 | 181 |
| | | E | 144 | 199 | 294 | 117 |
| | | C | 94 | 175 | 105 | 360 |
| 2 | 5·8 | T | 90 | 110 | 115 | 159 |
| | | A | 35 | 255 | 263 | 202 |
| | | B | 290 | 785 | 943 | 651 |
| | | E | 545 | 935 | 2790 | 1943 |
| | | C | 10 | 60 | 300 | 540 |
| 3 | 5·9 | T | 190 | 205 | 290 | 201 |
| | | A | 230 | 600 | 805 | 203·5 |
| | | B | 14 | 880 | 1100 | 331 |
| | | E | 95 | 155 | 460 | 299 |
| | | C | 140 | 160 | 580 | 257·5 |
| 4 | 6·4 | T | 150 | 180 | 90 | 985 |
| | | A | 160 | 525 | 470·5 | 657 |
| | | B | 95 | 380 | 342 | 960 |
| | | E | 60 | 730 | 1388 | 1888 |
| | | C | 10 | 145 | 116 | 380 |
| 5 | 6·6 | T | 940 | 1060 | 6570 | 960 |
| | | A | 290 | 550 | 4920 | 660 |
| | | B | 610 | 1285 | 8080 | 1160 |
| | | E | 305 | 695 | 1180 | 1260 |
| | | C | 755 | 915 | 4780 | 689 |

*Legend*: T = *E. typhosa*; A = Para A; B = Para B; E = *enteritis*; C = *E. coli*.

Further work on viability and the cultural, antigenic and other characteristics of these bacteria in the juice is in progress.

Microbiology Department,
St. Xavier's College,
Bombay,
*June* 6, 1948.

J. V. BHAT.
MADHU RAGHUNATH.

1. Bharucha, F. R., and Bharucha, K. H., *Jour. Univ. Bomb.*, 1938, **6**, 5, 35–40. 2. Bhat, J. V., Reporter, R. N., and Fernandes, F., *Curr. Sci.*, 1945, **14**, 324–25. 3. "*Times of India*," 1948, **110**, 107, 5.

## THE REFRACTIVE CONSTANT OF WHOLE AND SKIM MILK

THE measurement of refraction in milk as a means of detecting adulteration has already been reported.[1] The studies on adulteration with skim milk[1–2] showed that while the refractive index remains unaltered,[3–4] the rising density of the product steadily decreases

TABLE I

*Limits of Refractive Constant of Whole and Skimmed Cow and Buffalo Milk*

| | Density (20° C.) | | R. I. (40° C.) | Refractive Constant | |
|---|---|---|---|---|---|
| | Whole | Skim. | | Whole | Skim |
| Cow | 1·0274–1·0314 | 1·0342–1·0376 | 1·3458–1·3471 | 0·2065–0·2075 | 0·2059–0·2065 |
| Buffalo | 1·0258–1·0330 | 1·0324–1·0410 | 1·3471–1·3492 | 0·2076–0·2088 | 0·2058–0·2065 |

the value of the refractive constant. It was felt that elimination of fat, the most variable constituent of milk, might further narrow down the limits of the refractive constant. From the resulting data it would be possible to assess the advantage or otherwise of this value as compared with the refractive constant of whole milk.

45 samples of cow and buffalo milk of various grades of refractive index and density were used for this experiment. After taking the density (lactometer reading) of whole milk, the latter was separated in a hand-worked cream separator up to an upper limit of 0·2 per cent. fat in the skim milk. The density and refractive index (Abbe' refractometer) of the skim milk was then tested. The determinations on both skim and whole milk are given in Table I.

The data show that the limits of the refractive constant of average samples of milk are appreciably lowered and narrowed down by skimming. While for samples of whole cow milk the limits ordinarily lie between 0·2065 to 0·2075,[3] for defatted milk they lie between 0·2059 to 0·2065. For buffalo whole milk the constant lies between 0·2076 to 0·2088,[3] for defatted milk it is narrowed to 0.2060 to 0·2065 for average samples.

Now, it will be observed that the range of variation of the constant of skim milk of both cow and buffalo are almost identical. This is, of course, to be expected, as the solids-not-fat of the two milks do not differ to the same degree as do their fat contents. But this overlapping in the range of the constant of skim milk robs the advantage of distinguishing the two types of milk, possessed by the non-overlapping refractive constant of whole milk.[3] Further, the determination of the constant for skim milk denies the chance of detecting even gross adulteration with skim milk or of defatting.[2]

I am thankful to Prof. V. Subrahmanyan and Mr. B. N. Banerjee for their kind interest.

Department of Biochemistry, K. S. RANGAPPA.
Indian Institute of Science,
Bangalore,
*January* 14, 1947.

1. Rangappa, K. S., *Curr. Sci.*, 1946, **15**, 230. 2. —, (in Press). 3. —, *Proc. Indian Acad. Sci.*, B, 1947, **25**, 86. 4. —, *Nature*, **160**, 719.

## VISCOSITY OF LIQUIDS AND TEMPERATURE

A SIMPLE exponential relationship between viscosity and temperature has been proposed by different authors[1] in various forms, *viz.*,

$$\eta = A. e^{B/T}$$

where $\eta$ = Viscosity

A and B are constants characteristic of each liquid.

T = absolute temperature.

Recently, certain limitations of this equation have been pointed out by Leontieva.[2]

In the present note, an empirical relationship between viscosity and temperature has been proposed. When viscosity is plotted against temperature, a curve is obtained. The curvature is substantially diminished on plotting logarithm of viscosity against temperature. On plotting logarithm of logarithm of viscosity against temperature, straight lines were obtained for many liquids. An equation of the following type is, therefore, proposed:

$$\log (\log \eta) = A - BT$$

where $\eta$ = Viscosity in millipoises,

A and B are constants for each liquid

T = absolute temperature.

In the following table some typical examples are taken and the maximum differences between observed[3] and calculated values recorded:

TABLE I

| Compound | Temperature range in ° C. | A | B × 10³ | Maximum Percentage Difference + | − |
|---|---|---|---|---|---|
| Octane | 0–100 | 0·8036 | 3·20 | 1·4 | 0·7 |
| Nonane | 0–100 | 0·8568 | 3·16 | 0·2 | 1·0 |
| Benzene | 0 70 | 0·9353 | 3·50 | 0·3 | 0·5 |
| Chloroform | 0–60 | 0·6283 | 2·57 | 0·5 | 0 |
| Acetone | 0–50 | 0·7953 | 3·71 | 1·4 | 0·3 |
| Ethyl Iodide | 0–70 | 0·6018 | 2·45 | 0 | 0·2 |
| Ethyl Formate | 0-53 | 0·7864 | 3·43 | 1·0 | 0·1 |
| Butyl acetate | 0–100 | 0·8628 | 3·16 | 0 | 1·0 |
| Acetic acid | 25–95 | 0·8085 | 2·63 | 0·8 | 0·3 |
| Methyl alcohol | 0–60 | 0·9710 | 3·70 | 1·8 | 0·7 |
| Trimethyl carbinol | 32–77 | 1·9385 | 5·80 | 1·1 | 0·5 |
| Ethyl propyl-ether | 0–60 | 0·9470 | 4·26 | 2·3 | 1·0 |

The case of water deserves special attention. Andrade[4] found that equation (1) expresses

the viscosity of water within 0.5 per cent. from 100° C. to 60° C. Equation (2) gives the viscosity of water fairly correctly between 100° and 20° C. as may be seen from the table below. Lewis and Macdonald[5] have measured the viscosity of heavy water between 5° and 35° C. which also agree very closely with the calculated values:

TABLE II

Water : $A = 1\cdot 23$ ; $B = 4\cdot 3 \times 10^{-3}$

| Temp. in ° C. | Observed viscosity in millipoises | Calculated viscosity | % diff. |
|---|---|---|---|
| 0 | 17·93 | 16·56 | −7·6 |
| 10 | 13·09 | 12·71 | −3·0 |
| 20 | 10·06 | 10·00 | −0·6 |
| 30 | 8·00 | 8·048 | +0·6 |
| 40 | 6·57 | 6·613 | +0·7 |
| 50 | 5·50 | 5·534 | +0·6 |
| 60 | 4·71 | 4·71 | 0 |
| 70 | 4·07 | 4·069 | 0 |
| 80 | 3·57 | 3·566 | −0·1 |
| 90 | 3·16 | 3·162 | +0·1 |
| 100 | 2·84 | 2·837 | −0·1 |

TABLE III

Heavy Water : $A = 1\cdot 431$ ; $B = 4\cdot 74 \times 10^{-3}$

| Temp. in ° C. | Observed viscosity in millipoises | Calculated viscosity | % diff. |
|---|---|---|---|
| 5 | 19·88 | 19·95 | +0·4 |
| 10 | 16·85 | 16·87 | +0·1 |
| 15 | 14·51 | 14·49 | −0·1 |
| 20 | 12·60 | 12·65 | +0·4 |
| 25 | 11·03 | 11·02 | −0·1 |
| 30 | 9·72 | 9·74 | +0·2 |
| 35 | 8·64 | 8·62 | −0·3 |

The applic tion of this relationship at high temperatures will be discussed in a later communication.

My grateful thanks are due to Dr. M. R. A. Rao for kind advice.

B. K. BANERJI.

Department of General Chemistry,
Indian Institute of Science,
Bangalore,
June 12, 1948.

1. Raman, *Nature*, 1923, **111**, 532; Dunn, *Trans. Farad. Soc.*, 1926, **22**, 401; Andrade, *Nature*, 1930, **125**, 309; Sheppard, *Ibid.*, 1930, **125**, 309. 2. Leontieva, *Acta physicochimica U. R. S. S.*, 1947, **22**, 279. 3. "International Critical Tables and Landolt Bornstein Tabellen." 4. Andrade, *Nature*, 1930, **125**, 583. 5. Lewis and Macdonald, *J. I. C. S.*, 1933, **55**, 4730.

## HEAT CONDUCTIVITY AND MOLECULAR COMPLEXITY OF WATER—PART II

THE author has shown previously[1] that the heat conductivity K of water decreases sensibly linearly with its degree of association $n$. That the data can be represented by the equation $K = 0\cdot 002282 - 0\cdot 0002389\ n$ is evident from the following table:

| $t$ (° C.) | $n$ | $K_{obs.}$ | $K_{calc.}$ |
|---|---|---|---|
| 10 | 3·86 | 0·00136 | 0·00136 |
| 20 | 3·60 | 141 | 1422 |
| 30 | 3·40 | 1455 | 147 |
| 40 | 3·24 | 1493 | 1508 |
| 50 | 3·12 | 1527 | 1536 |
| 60 | 3·01 | 1563 | 1563 |
| 70 | 2·90 | 1589 | 1589 |

The variation with $t$ of K for water[2] follows the equation $K = 0\cdot 001325\ (1 + 0\cdot 002984\ t)$.

Department of Chemistry, S. R. MOHANTY.
Benares Hindu University,
June 8, 1948.

1. Mohanty, *Curr. Sci.* 1947, **16**, 339. 2. Jakob, *Ann. der Phys.*, 1920, **63**, 537.

## *DARLUCA FILUM* (BIV.) CAST., A HYPERPARASITE OF *PUCCINIA GRAMINIS* AND *PUCCINIA TRITICINA* IN THE GREENHOUSE

IN INDIA, Butler and Bisby[1] recorded the occurrence of *Darluca filum* on uredinia of *Puccinia polygoni-amphibii*, Ramakrishnan and Narasimhalu[2] on *Puccinia purpurea*, *P. penniseti* and *Uromyces setariæ-italicæ*, Padmanabhan and Rafay[3] on *P. kuehnii* and Padwick[4] on *P. chrysopogi*, *Uromyces inayati* and *U. andropogonis-annulati*. During the course of the study of wheat rusts at Simla, the writer observed the pycnidia of *Darluca filum* on the uredinia of *Puccinia graminis* and *P. triticina* every year in the greenhouse in July, August and September when humidities are high (80-100%). It was found to be fairly troublesome in maintaining rust cultures since, in some cases, the pustules were almost destroyed. The pycnidia which are small, black, spherical and shiny, are found scattered amongst the uredospores. When put in a drop of water on the slide, long tendrils of colourless spores are seen to ooze out through circular openings of the pycnidia. These spores are either aseptate or uniseptate, oblong and straight, with or without small cilia at the ends and measure 3-5 × 9-25 $\mu$.

Inoculations made in the greenhouse during July-September on wheat seedlings with infected material of *Puccinia graminis* and *P. triticina* resulted in the appearance of the rust pustules on which the pycnidia of *Darluca filum* were formed within 4-5 days in every case. Finally the infected pustule fell off from the leaf leaving a shot-hole. When these plants were removed from the greenhouse to a dry place soon after the formation of shot-holes, the rust continued to develop round the shot-holes and *Darluca filum* disappeared. If the plants were removed to a dry place before the formation of shot-holes, the uredinia were

formed in the normal way and after some time, no trace of *Darluca* was left.

Simultaneous inoculations made with infected rust spores on the plants maintained at a lower humidity resulted only in the formation of uredinia without its parasitizing fungus. Among the greenhouse cultures too *Darluca filum* disappeared after the rainy season.

These experiments, when considered with the observations made in the greenhouse for several years, show that *Darluca filum* can develop on these rusts only in very humid conditions as are prevalent in the hills during the rainy season.

Padwick[4] collected *Darluca filum* on *Puccinia chrysopogi* Barclay and *Uromyces inayati* Syd. in the last week of September at Simla. So far as the measurement of spores is concerned there seems to be little doubt that his collections and the fungus described here belong to the same species of *Darluca*. According to Keener,[5] Trayler[6] and Hardison[7] successful infection of several grain and grass rusts has been obtained by means of cross-inoculations with *Darluca filum* and it is quite likely that the greenhouse infections described here may be wind-borne from some grass rust infested with this parasite. Keener's[5] experiments, moreover, indicate that there are physiologic races in *Darluca filum* since any two collections may not behave alike in their rust host range.

Concerning the usefulness of *Darluca filum* in the control of cereal rusts in nature, it is apparent from what has been described here, that the growth of this fungus is largely governed by atmospheric humidities. It develops best where there is high humidity approaching 80-100%. In nature, such a state of affairs rarely, if ever, continues for long periods, specially during the wheat growing season. It is, therefore, useless to attempt to control wheat rusts in the field by *Darluca filum*.

RAGHUBIR PRASADA.

Division of Mycology and Plant Pathology,
Indian Agricultural Research Institute,
New Delhi,
*March* 6, 1948.

1. Butler and Bisby, *Sci. Monogr. Imp. Coun. Agric. Res. India*. 1931, **1**, 154. 2. Ramakrishnan and Narasimhalu, *Curr. Sci*, 1941, **10**, 290. 3. Padmanabhan and Rafay, *Curr. Sci.*, 1942, **11**, 151. 4. Padwick, G. W., *Imp. Mycol. Inst. Mycological Papers*, 1945, **12**, 6. 5. Keener, P. D., *Bull. Torr. Bot. Club*, 1934 **61**, 475-490. 6. Trayler, J. A., *Proc. Okla. Acad. Sci.*, 1940, **20**, 57-58. 7. Hardison, J. R., *U.S. Dept. Agr. Pl. Dis. Rep.*, 1942, **26**, 67-75.

## POTATO NECROSIS

*Introductory.*—Some of the potato plants of variety *Darjeeling Red Round* raised in the insect-proof house from virus-free seed tubers, stock of which had been built up during the last few years suddenly developed necrosis of the growing point which spread downwards and gave the plants wilted appearance. The leaves became pale and flascid and most of the plants were killed in due course. This was a very serious matter as part of the nucleus disease-free seed of this variety produced after considerable labour and expense was about to be lost. The problem needed immediate attention and investigation into the cause of the disease was taken up. The young leaflets near the growing point of the infected plants show outward, or inward curling of margins and some smalling and narrowing of young leaves may also be observed in certain cases. After about a week light diffused brown areas develop in the top leaves which after a few days turn completely brown and dry up. Later on the outward curling of margins progresses to all the leaves of the plant and the tips of leaves point downwards. Ultimately the necrosis first observed at the growing tip progresses down and the plant is usually killed. Fig. 1 shows a plant of potato variety *Darjeeling Red Round* affected by the disease. In addition, virus-free potato plants of varieties *President* and *Craig's defiance* which were being grown as differentials for analytical work on potato viruses were also found affected by a disease characterised by smalling and curling of margins of younger leaves. The leaves also exhibited diffused light brown areas resulting in drying up of the top leaves. The plants were, however, not killed as a result of the disease.

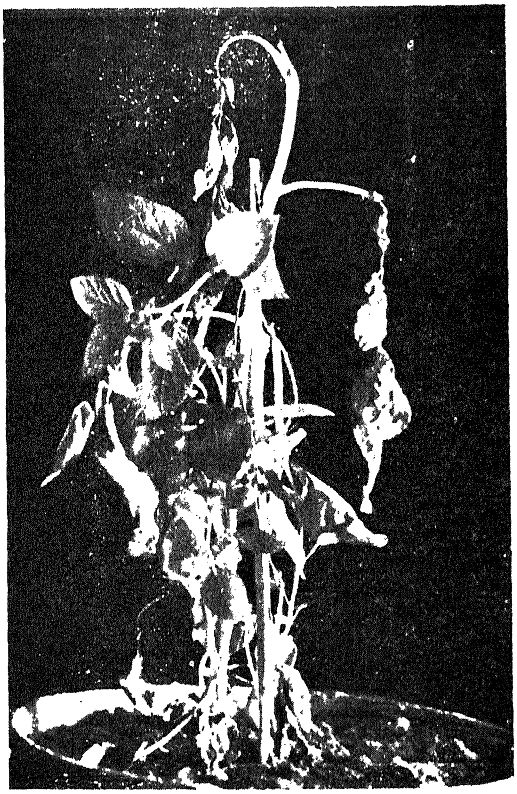


FIG. 1

*Transmission of the disease.* The experimental work was carried out in an insect-proof glasshouse and always young vigorously grow-

ing healthy plants were used for transmission tests. All attempts to transmit the disease to potato plants by inoculation in the presence of carborundum powder as abrasive were unsuccessful. Also the disease could not be transmitted by mechanical means to a number of solanaceous hosts, *e.g.*, *Nicotiana tabacum* L., varieties White Burley and Harrison's Special, *Nicotiana glutinosa* L., *Datura stramonium* L., *Nicotiana sylvestris* Spegaz and Comes, *Solanum nigrum* L., *Capsicum annuum* L., *Petunia hybrida* Vilm. and *Lycopersicum esculentum* Mill. variety Sutton's Early Market. The disease was, however, successfully transmitted by grafting the diseased scions to healthy stocks of potato and certain other plants. Grafting was done both by wedge method as well as inarching and reactions on differential hosts were studied. As the disease was found to be transmissible only by grafting, it was necessary to investigate the cause of infection in the hitherto disease-free potato plants. It was observed that incidence of whitefly, *Bemisia gossypiperda* M. and L. was high in the fields during the period under report. Experiments were, therefore, conducted to investigate if white fly was responsible for transmission of the disease. Insects were fed on diseased plants in micro-cages and then transferred to healthy plants of *Nicotiana tabacum,* variety Harrison's Special and *Lycopersicum esculentum.* The insects were allowed to feed for 24 hours on diseased as well as on healthy plants. In the case of tomato after 11 days yellowish diffused mottle appeared on the leaves and all the newly formed young leaves showed slight twisting; with age the mottle became more pronounced. The young newly formed leaves of tobacco exhibited faint mottle and the leaves became narrow. Also tips of the leaves showed slight curling. The insect transmission tests were not conducted on potato due to non-availability of sufficient number of virus-free potato plants at that time.

*Reactions on Differential Hosts, Lycopersicum esculentum, variety Sutton's Early Market.*—In tomato two weeks after grafting with diseased potato plants of *Darjeeling Red Round* variety distinct mosaic mottle appeared on all the newly formed leaves which was followed by reduction in the size of leaves. The young leaflets were elongated and narrow with curled margins. Some of the leaves were wrinkled and twisted so much so that they exhibited cork-screw distortion. The older leaves showed leafcurl with tips of leaves forming a characteristic hook-like structure. With age the mottling became faint but smalling of leaves in the shoots and the hook-like structure persisted.

*Nicotiana tabacum.*—In variety Harrison's Special two types of symptoms were observed. All the plants invariably produced transient mottle in 13-20 days on all the new leaves. This was followed by a pronounced stunting of the plant and shortening of internodes. The mottling disappeared after a few days and the plant carried the disease without obvious symptoms. When scions from such tobacco plants were grafted to tomato typical symptoms of the disease appeared. In other cases the leaves of infected tobacco plants exhibited slight curling, twisting, bending of tips and narrowing. Though the source from which diseased scions were obtained was the same it produced two different types of symptoms in tobacco plants which may be due to difference in reaction of individual plants.

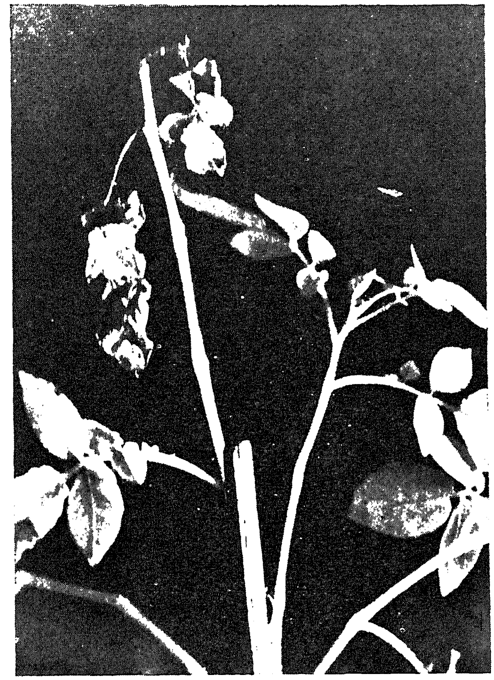


FIG. 2.

*Solanum tuberosum.*—The disease was successfully transmitted to potato plants of varieties *Phulwa, Craig's defiance, President* and *Arran Victory.* The *Phulwa* plants only exhibited foliar necrosis whereas in *Craig's defiance* the disease produced smalling and necrotic areas on young leaves. In potato variety *President* the top young leaves completely turned brown and dried up whereas the young leaves of variety *Arran Victory* developed necrotic areas and later turned completely brown. Fig. 2 shows an infected *Arran Victory* plant. All efforts to transmit the disease to *Lagenaria vulgaris* Seringe were unsuccessful.

The symptoms on differential hosts show that necrosis in *Darjeeling Red Round* variety had been caused by a mild strain of tobacco leafcurl virus (*Nicotiana virus* 10). This view is further confirmed by the fact that the disease is transmitted by *Bemisia gossypiperda* M. and L., vector of the tobacco leafcurl virus. In India tobacco leafcurl virus is wide spread and is responsible for serious losses to the crop. The disease has a wide host range and may, therefore, become a limiting factor in the cultivation of potato crop.

R. S. VASUDEVA.
R. N. AZAD.
Div. of Mycology & Plant Pathology,
Indian Agricultural Research Institute,
New Delhi,
*June* 23, 1948.

## ERGOT SCLEROTIA ON *SORGHUM VULGARE* PERS.

The incidence of the sugary disease of *Sorghum* caused by *Sphacelia sorghi* McRae in South India is observed almost annually in crops maturing in December-January. But in this province the sphacelial stage alone had been recorded so far. Ajrekar (1926) has described that sclerotia were formed but that they were overgrown with *Cerebella* and yeasts and that they did not germinate. Barger (1931) states that "a specimen of *Sorghum* in the herbarium of the Imperial Bureau of Mycology shows numerous slightly curved sclerotia, 10 to 12 mm. × 2 mm." Robertson (1928) reported long hard horn-like sclerotia on *Sorghum* from Burma.

In November 1946 heavy incidence of sugary disease of *Sorghum* was noticed in Koilkuntla, Kurnool District (Madras Province). Specimens of ears obtained from this area exhibited profuse sclerotial formation. Almost every other spikelet had one cylindrical, elongated or slightly curved sclerotium of cream to grey colour. These were 1 to 2·5 cm. long and 4 to 6 mm. thick and to all appearances resembled young sclerotia of ergot of rye. Some of these sclerotia were kept in moist sand at 5° C. for over one month and then removed to 20° C. But there was no sign of germination even after three months.

A cluster of 3 spikelets with sclerotia and a single sclerotium ( × 1·25 )

Surface sterilized sclerotia were cut into bits and kept on Kirchoff's medium. Mycelial growth developed and from this the fungus was multiplied. The growth of the fungus on Kirchoff's medium was white in colour with plenty of ærial hyphæ. But the rate of growth was very slow compared to that of ergot of rye. At laboratory temperature (26° C. – 28° C.) the growth was slower than at 20° C. – 23° C. Sporulation was evident in fifteen to twenty days. The conidia were of various shapes and sizes. Some were like the conidia found in nature. Others were smaller, oval or elongated and narrow. Transfers were made on sterilized young panicles of *Sorghum* and greater sporulation resulted on this substrate.

A suspension of the spores from the cultures was used for inoculation of young flowers of *Sorghum*. It was sprayed by an atomizer before the flowers opened, at the time of flower opening and after the anthers had all been shed. Successful infection was easily obtained in the first two stages, the highest incidence occurring when inoculation was carried out at the time of flower opening. At Coimbatore, however, only the 'honey-dew' stage developed. The sclerotium did not develop in any of the infected ears. Obviously a cooler climate is necessary for this, as the occurrence of the sclerotia has been observed only at higher latitudes.

The sclerotia were assayed following the method described by Mukerji and De (1944). There was not the slightest trace of the blue colour in the extract after the addition of the reagent indicating thereby that ergotoxine is not present in the sclerotia. Consequently ergot poisoning is not to be expected when cattle are allowed to eat ergotized ears of *Sorghum*.

Mycology Section, Agri. Res. Institute, Coimbatore, T. S. Ramakrishnan.
*June* 25, 1948.

1. Ajrekar, S. L., *Jour. Ind. Bot. Soc.*, 1926, **2**, 55–61. 2. Barger, G., *Ergot and Ergotism*, Gurney Jackson, London, 1931, p. 111. 3. Robertson, H. F., *Ann. Rep. of Mycologist, Burma*, 1928, Abs. *Rev. App. Myc.*, 1929, **8**, 255. 4. Mukerji, B., and De, N. K., *Curr. Sci.*, 1944, **13**, 128.

## A UNIQUE CASE OF ARTERIAL ABNORMALITY IN *RANA TIGRINA* DAUD.

Although numerous cases of abnormalities in the Venous System of the Anura have been recorded from time to time, very few instances affecting the aortic arches have been hitherto noted. Crawshay (1906)[1] described a female individual of *Bufo boreas*, in which there was a common systemico-pulmonary arch on the right side posterior to the origin of the large cutaneous artery. Sweet (1909)[2] found an abnormal connection between the internal carotid and the systemic in an individual of *Hyla aurea*, as well as two cases of the presence of accessory aortic arches in the same species. Benham (1919)[3] in *Hyla aurea*, and O'Donoghue (1933)[4] in *Rana temporaria*, recorded in certain cases the abnormal presence of four aortic arches instead of three. Mozejko (1919)[5] reported on the absence of the left pulmocutaneous arch in *Rana esculenta*, and

Young (1924)[6] on the absence of union between the two systemics in *Rana pipiens*. Avel (1929)[7] found that in a specimen of *Bufo vulgaris* the right subclavian artery arose from the pulmocutaneous arch at the point of its bifurcation, while in another specimen the cutaneous artery arose from the left aortic arch. O'Donoghue (1931)[8] recorded in *Rana temporaria* the absence of that portion of the right systemic arch which normally lies between the point of origin of the subclavian and the junction of the two systemics, and also discovered (1935)[8] an abnormal occipital artery arising from the systemic arch, as well as an deserves mention. The individual was an adult male, and had been injected by me with carmine.

The arrangement of the arteries (Fig. 1) was normal on the right side, but on the left only two arches arose from the truncus arteriosus—a systemico-carotid arch and a pulmocutaneous one. The latter showed a normal distribution, but the former—the first case of a joint trunk of this type in the Anura—gave off the left external carotid artery a little way off from its point of origin, had a carotid labyrinth immediately distal to the origin of this artery, and passed from this point outwards, back-

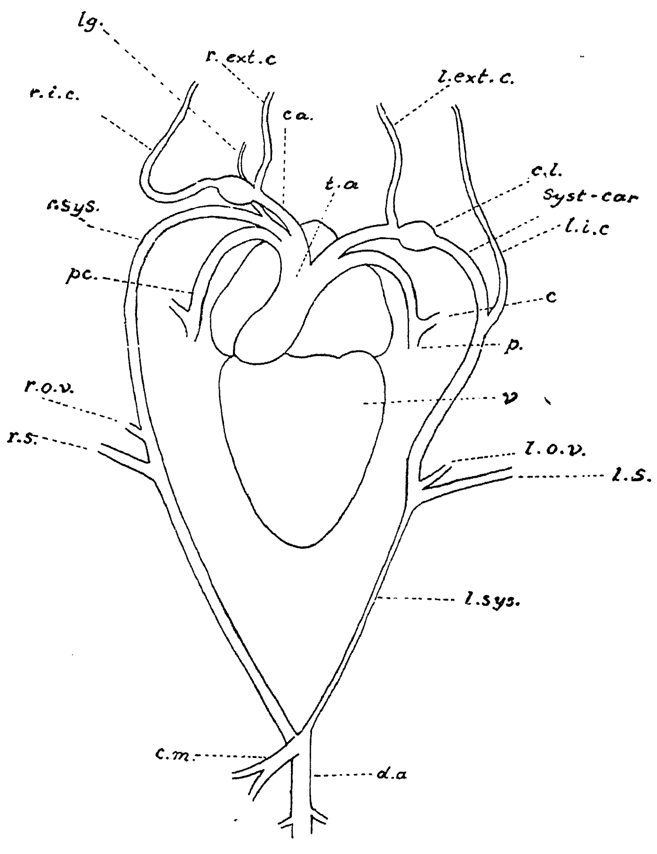



FIG. 1. Disposition of the main arteries in the abnormal specimen of *Rana tigrina*. *c*, cutaneous artery; *ca*, Carotid trunk; *c. l.*, Carotid labyrinth; *c. m.*, Cœliaco-mesenteric artery; *d. a.*, dorsal aorta; *l. ext. c.* left external carotid artery; *lg.*, laryngeal artery; *l. i. c.*, left internal carotid; *l. o. v.*, left occipito-vertebral artery; *l. s.*, left subclavian artery; *l. sys.*, left systemic arch; *p.*, pulmonary artery; *pc.*, pulmo-cutaneous trunk; *r. ext. c.*, right external carotid artery; *r. i. c.*, right internal carotid artery; *r. o. v.*, right occipito-vertebral artery; *r. s.*, right subclavian artery; *r. sys.*, right systemic arch; *syst-car.*, abnormal systemo-carotid trunk of the left side; *t. a.*, truncus arteriosus; *v.*, ventricle.

abnormal subclavian, in *Rana temporaria*; while Khatib (1938)[9] noticed a case of *Rana tigrina* in which two vessels arose close together from the right systemic arch at its origin, the inner one joining with the external carotid by a branch.

This year I came across a unique case of aortic abnormality in *Rana tigrina* Daud., which

wards, and upwards to assume a dorsal position. The left internal carotid artery arose not from the carotid labyrinth as is usual, but quite a way off from it from the conjoint systemico-carotid trunk near the dorsal region of the œsophagus. Thus, on account of its posterior origin, it was more elongated than the right one. After the origin of the left

internal carotid, the arch passed obliquely backwards towards the median line and, after giving rise to the subclavian artery, became an extremely attenuated vessel, running backwards as the left systemic trunk to join its fellow of the other side. The presence of the injection mass inside showed that this attenuated section of the systemico-carotid trunk was a vessel, and not a ligamentous structure. There was no left laryngeal artery, and the occipito-vertebral and subclavian arteries, unlike those of the right side, arose from a common point from the left systemico-carotid trunk.

When we compare this abnormal disposition of arteries with the normal condition found in *Rana tigrina*, the deviation appears to be due to the fact that the carotid and systemic arches of this side are not separated from each other, but remain as a single undivided trunk a view which is supported by the absence of a partition separating the carotid and systemic channels from each other inside the conjoint vessel. The attenuation of the systemic artery posterior to the origin of the left subclavian may be correlated with the extremely small amount of blood left over to be transmitted from this side to the dorsal aorta.

The presence of a conjoint systemico-carotid arch in this case reminds one of the Reptilian condition where such an arch is present normally, although on the right side.

I am extremely grateful to Prof. B. C. Mahendra for his guidance and help in the preparation of the present note.

RADHA KRISHNA KAUSHIK.
Department of Biology,
Birla College,
Pilani,
*April* 23, 1948.

1. Crawshay, L. R., "On Variations in the Arterial System of Certain Species of the Anura", *Proc. Zool. Soc.*, London, 1906, 1008. 2. Sweet, G., "Variations in the Anatomy of *Hyla aurea*," *Proc. Roy. Soc. Victoria*, 1908, **21**, 349. 3. Benham, W. B., "On the Occurrence of two Unusual Bloodvessels in *Hyla aurea*," *Trans. New Zealand Inst.* May 1919, 39. 4. O'Donoghue, C. H., "Abnormalities in the Blood Vascular System of Four Frogs," *Anat. Anz.*, 1933, Bd. **75**, Nr. 21/22, 468–71. 5. Mozejko, B., "Ein interessanter Fall von Anomalie der Aortenbogen bei einer *Rana esculenta*," *Anat. Anz.*, 1909, Bd. **34**, 476. 6. Young, D. B., "Abnormal Circulatory System of a Frog," *American Nat.*, 1924, **58**, 287. 7. Avel, Marcel, "Deux Anomalies du systéme artériel chez le crapaud (*Bufo vulgaris* Laur.)," *Bull. Soc. Zool. France*, 1929, **54**, 590–94. 8. O'Donoghue, C. H., "Futher Anomalities in the Blood Vascular System of Frogs," *Journal of Anatomy*, 1935, **70**, 1, 159–160. 9. Khatib, S. M. Husain, "Four Cases of Abnormalities in the Blood Vascular System of the Common Indian Frog (*Rana tigrina* Daud.)," *Proc. Ind. Acad. Sci.*, 1938, **7**, Section B, 277-85.

## THE VASIFORM ORIFICE OF LARVAL ALEURODIDÆ

THE vasiform orifice constantly present in all Aleurodids, is one of the major characters on which the generic classification of the group is based. There has been a considerable difference of opinion regarding the morphology and function of the operculum and the lingula, which are invariably associated with the orifice (Fig. 1). Peal[1] considered the vasiform orifice as a special secreting structure and honey dew to be connected in some way with the circulation of the larva. Bemis[2] appears to have a somewhat similar idea about the lingula. According to her in some species, there are seen minute blunt tubes on the apex of the lingula, through which the fluid may be secreted. Tullgren[3] regarded the vasiform orifice as the anal opening. Quaintance and Baker[4] believed that the anus opened below the lingula, which therefore, functioned as the supra-anal plate, the operculum being the rolled back edge of the lingula. Hargreaves[5] showed that the anus opened above and not below the lingula.

My studies on the fourth instar larva of *Dialeurodes eugeniæ* Maskell clearly show that

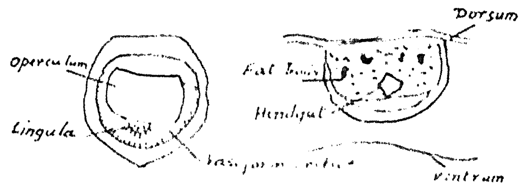



FIG. 1. Dorsal view vasiform orifice FIG. 2. T. S. through vasiform orifice

the vasiform orifice is a shallow depression of the dorsum, lodging the operculum and the lingula within (Fig. 2). Both the operculum and the lingula are hollow, containing extensions of the haemocœle. Therefore they should be regarded as abbreviated abdominal segments of the larva. The structures regarded as tubes by Bemis are merely cuticular spines. The posterior part of the hindgut traverses through the operculum and terminates into the anus above the anterior end of the lingula. The operculum is provided with muscles and by its forceful movement against the lingula squirts out the liquid faecal matter in the form of a droplet, at some distance from the body of the larva. The elongated and setose form of the lingula appears to guide the outward flow of the faecal drop. The pit of the orifice probably enhances the free movement of the operculum and the lingula enabling the larva to jet out faecal drops in several directions. In short, the three structures form a mechanism for the proper defeciation of the larva. A full account of the larval anatomy will be published elsewhere.

Robertson College, KARAM SINGH.
Jubbulpore,
*May* 6, 1948.

1. Peal, *Jour. Asiatic Soc. Bengal* 1903, **72**, 65. 2. Bemis, *Proc. U. S. Nat. Mus.*, 1904, **27**, 475. 3. Tullgren, *Arkiv. f. Zoologi.*, 1907, **3**, 3. 4. Quaintance and Baker, *U. S. Dept. Agri. Bur. Ent. Tech. Ser.*, 1913, **27**, 8. 5. Hargreaves, *Ann. Appl. Biol.*, 1915, **1**, 310.

# REVIEWS

**Weapons of World War II.** By Major-General G. M. Barnes. Pp. xiv + 317. (New York: D. Van Nostrand Co. Inc.; London: Macmillan & Co., Ltd.). 42 *sh.* net.

The World War II has seen very substantial advances in weapons and equipment as regards both technique and fundamental concepts and there could be few officers better qualified to discuss these than Major-General Barnes, Chief of the Ordnance Department, USA Army, during the war years and with a service of 36 years in the regular army. Major-General Barnes' book which succeeds in making a survey of the American work in the field so opened up, is therefore most welcome and is, I believe, the first comprehensive publication of its kind.

This profusely illustrated volume is not a mere catalogue with explanatory notes on each item but it gives a vivid and authentic picture of a vast number of widely differing types of army and air-force weapons necessary to equip a modern army. The treatment of the topics is necessarily brief on account of the wide range covered but in general the essentials are emphasized and a satisfactory story presented. Particularly valuable features of the book are that development and action photographs of weapons and vehicles are given, their principal characteristics are set forth in full in a tabular form easy for reference, the highlights of their development are discussed and the role that each played during the war is mentioned. An appreciation can therefore be made of their relative merits and fields of application.

There is an excellent description of the organisation, charter, activities and various committees of the Ordnance Department of the USA Army in the Introduction. It may be mentioned here that the corresponding organisation for research and development in the UK is under the Ministry of Supply instead of under the Army.

The first five chapters in the book deal with arms and ammunition, and the latter two with 'A' and 'B' vehicles, new apparatus and instruments. The last chapter contains the author's conclusions. This is a very satisfactory arrangement.

Chapter I deals with the design and development of small arms and ammunition, those requiring special mention being the automatic rifle, 'bazooka', recoil-less rifles and the aluminium—nylon principle for body armour.

Chapter II lays down the basic characteristics of anti-aircraft armament and describes aircraft cannon of calibres 20 mm. and larger.

Chapter III deals with the design and development of improved types of ammunition such as explosives (RDX, PETN, cyclonite, Haleite), propellants and primers, flash reducers, shaped charges (hollow charges), artillery fuses specially the VT fuse, grenades, both hand and rifle, mines, anti-tank and anti-personal, mine exploders, signals and flares, bombs of various types including anti-ricochet attachments for general purpose bombs.

Chapter IV deals with the design and development of all types of field artillery (light, medium and heavy) provided with accurate fire control instruments and 'capable of functioning efficiently equally well on the Arctic Circle or at the Equator'. Development of anti-aircraft weapons of various calibres is also described together with automatic anti-aircraft fire control system worked by electronic power control. This is followed by a description of the development of mortars and ammunition of calibres commencing from the small 60 mm. existing before the war, through intermediate sizes, to the 941 mm. Mortar (36″ in bore).

Chapter V traces the development of rockets of various types and sizes, their launchers and propulsion units.

Chapter VI, the largest in the book, is devoted to the design and development of both 'A' and 'B' type vehicles which include Tanks (light, medium and heavy including swimming devices for the first two categories), armoured cars, self-propelled gun carriages for light as well as heavy guns, and various types of army transport vehicles such as trucks, high speed tractors, tank transporters, cargo carriers and particularly trucks amphibian (DUKW).

That these amazing advances in design, development and production of the weapons and vehicles described so far would not have been possible but for the *pari passu* development, standardisation and conservation of materials and their substitutes, is dealt with in Chapter VII. Investigations into designs and development of existing and new weapons of warfare and in their accurate use were very much facilitated by new apparatus and instruments such as Electronic Computing Devices, Supersonic Wind Tunnel, Aerodynamic Spark Range, Blast measuring instruments, Ballistic Camera, Flash X-ray apparatus and technical intelligence reports about enemy Ordnance including those then in their research and development stage.

The author emphasises that the partnership formed by the Ordnance Department with American Science and Industry, what he calls the Science-Industry-Ordnance team, yielded results beyond expectation in the design, development and production of Ordnance equipment and he is full of praise for the sound work done by the numerous Scientific and Engineering Advisory Committees. He advocates in the concluding chapter that—

(*i*) No service laboratories be established except for those fields which are not covered by university, private and industrial laboratories.

(*ii*) Research and development problems of the Services be "farmed out" to qualified universities, private and industrial laboratories.

(*iii*) Preparations should be ready for prompt mobilization of the entire industrial capacity of the nation, with its man-power.

The style of presentation in the book is narrative and lucid and it provides interesting

reading. There is no displacement of photographs with respect to the text, there are hardly a few trivial misprints and there is a good and adequate index at the end. The book is well produced.

Major-General Barnes' book will prove to be of great interest to all scientific and technical men who have a specialist interest in the research and development of weapons and equipment for the Services, to Army Officers who will find it useful as a reference book wherein the characteristics and performances of various American arms and vehicles can be readily seen, and to general readers to enable them to obtain sufficient grasp of the advances so far made to follow the current development.

R. S. THAKUR.

**One, Two, Three ..., Infinity.** By George Gamow. (London: Macmillan & Co.) Pp. 340.

A popular book dealing with facts and speculations of Science, written by a distinguished Professor of Theoretical Physics, one who has already other popular books on Science to his credit, is bound to deserve attention and to be widely read. Looking at the title of the book, one will possibly expect in it an account of the mysteries of numbers, or some such topic. But, glancing through the pages, some may exclaim whether 'infinity' refers to the number of topics dealt with, for we find therein topics on ordinary numbers, enumerability, number of primes between 1 and N, the four-colour problem, Möbius surface, Relativity, atomic structure, nuclear physics, problems on probability, the living cell, chromosomes, bacteria, stars and the Galaxy, the origin of the solar system, Interior of the stars, the expanding universe, and so on. A careful and intelligent study however reveals that all these topics group themselves under four broad divisions: Numbers, Space and Time, the beginning and mechanism of Life, and the Origin of the Universe. These are harmoniously welded together so as to form a "Study of the Universe as interpreted by scientific observation". From this broad standpoint of view, the book is illuminating, and provides for the layman as well as for the scientific explorer, a most enjoyable book for his leisure hour. "The time has come", the Walrus said, "to talk of many things", and we warmly congratulate Prof. Gamow on his assuming the role of the Walrus so successfully.

C. N. S.

**Modern Magnetism.** By L. F. Bates. (Cambridge University Press, Second Edition 1948. Pp. xii × 440.) Price 25 *sh.* nett.

The first edition of this book was published in 1939. The aim was to present a detailed account of the fundamental experiments in magnetism with the necessary background of modern theory. The book was no doubt greatly appreciated by workers in the field of magnetism.

Since the publication of the first edition, much new material has been collected in spite of the handicaps brought about by the War. The phenomenological theory of hysteresis, described by Becker and Döring in their book *Ferromagnetismus* (Springer, 1939) gave a new and logical interpretation to domain structure. Considerable fundamental work has been carried out on the preparation of high permeability alloys. Very exciting results have been obtained by radiofrequency techniques with molecular beams. An interesting example is the case of the discovery of the existence of a quadrupole moment in the deuteron. Considerable work had been done during the war years in the Netherlands or paramagnetic dispersion and absorption.

Most of this new material has not so far been presented in book form. Professor Bates, who has himself contributed much to this extension of magnetic knowledge, has done a great service to workers in Magnetism by collecting this large amount of interesting information and presenting the details in a connected form. The additional information has been given in the form of six new chapters and a few supplementary notes.

Apart from specialists in magnetism, students of the physical sciences will find much in these chapters that would be of great interest and importance.

S. R. R.

**Cathode-Ray Oscillograph in Industry.** By W. Wilson, Third Edition Revised, 1948. (Messrs. Chapman & Hall, London.) Pp. xii + 252. Price 18 *sh.*

The second edition of this book was reviewed in *Curr. Sci.* in considerable detail and was noticed as a very useful addition to the available literature. Hence, it is proposed to refer only to the special additional features of the third edition only.

The section on the fluorescent screen has been re-written and the literature published recently in the *I.E.E.*, Part III —Radio Location Convention, has been usefully utilised. This is a necessary and an important change. A very useful discussion on the advantages, etc., of the two types of deflection, *viz.*, electrostatic *v.* magnetic deflection has been added. There is an Appendix F dealing with the recent developments employed in Radio Location. Herein, some of the wartime developments like the P. P. I., the post-deflection acceleration, Lens magnification of the screen, etc., are briefly but very simply and clearly described. The author had to resort to this procedure of putting all this in a short appendix owing to the printing difficulties. It is to be hoped that all these features will come up for a non-detailed description in the next edition.

The third edition is definitely an improvement and increases further the utility of this excellent book.

S. V. CHANDRASHEKHAR AIYA.

**Glacial Geology and the Pleistocene Epoch.** By R. F. Flint. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd.) 1947. Pp. xviii + 589. $ 6·00.

Students of the Pleistocene epoch owe a debt of gratitude to Professor Flint of Yale University for this invaluable book. As the title indicates, the book does not deal with every phase of the Pleistocene. Information regarding this Epoch has grown so rapidly that a complete reference work would become very

voluminous. In Historical Geology, the longest and most important chapter is upon the latest and shortest of the geological periods. The author has not, therefore, attempted to make the book an encyclopædia but a summary of the essential features of the Pleistocene epoch which could be of use not only to geologists, but to ecologists, archæologists, and geographers.

The book is essentially a discussion of the Pleistocene epoch from the point of view of glaciation which is the special feature that distinguishes this epoch from the epochs that preceded it. The book, therefore, deals mainly with glaciation, its causes and its effects, and the criteria of its recognition.

What might otherwise have become a voluminous production has been avoided by a long list of references given at the end of the book which contains nearly 900 separate items; this is apart from numerous references found in the body of the book. There are six folded plates at back of book containing glacial maps. Included in the text-figures are 70 maps and diagrams, and 18 photographs. There are as many as 30 tables.

The book is a monument of careful and painstaking accumulation of a vast quantity of information. It will be widely welcomed not only by students of the Pleistocene Epoch, but by workers in other allied fields who are interested in problems of the prehistoric realm.

C. S. PICHAMUTHU.

**Insect Pests of Cotton in India.** By H. D. Nangpal. (Indian Central Cotton Committee.), 1948. Rs. 2.

This is a comprehensive list of the entire insect fauna associated with Cotton in India with a useful note on the cultivation of the crop in the different regions. While there is no doubt that all species dealt with affect the cotton crop at some stage or other in some part of the country or other, it would have been preferable if those species that are serious and important pests (like the Bollworms, for example) had been treated at much greater length. In its present form, therefore, this publication while serving as a guide to the cotton farmer or Agricultural Officer is not very useful to the working Entomologist as the information supplied is too meagre and elementary.

The book suffers from some omissions which seriously detract from its value for reference work. A map of India marking out the different cotton regions referred to in the introductory part would have been very useful; the total absence of illustrations of atleast the most important pest forms is a serious disadvantage especially to the lay reader wishing to derive practical instruction from the book. Even if colour plates are out of question in these difficult days simple line drawings of the different stages of important pests or reproductions of photographs would have served well. The arrangements of the pests under different heads is somewhat elementary and arbitrary; it may lead the lay reader to think that each species is definitely restricted to the stage and part of the cotton plant allotted to it in the book while this is not so. The bibliography attached to every species might have profitably included references to important recent work outside India. In the glossary of botanical 'terms' at the end, the repetition of botanical names in both the columns (where popular equivalents in English or vernacular are not available) serves no purpose, and the repetition of some names like Banyan tree, Cabbage and Euphorbia, is confusing; the vernacular equivalents are mostly all from North Indian languages and in a book covering cotton cultivation in the whole country the author could have taken pains to collect South Indian names also. Errors have been allowed to creep in here and there in regard to scientific names (Styled 'Latin' names in the text) of insects, probably by careless proof-reading. In the next reprint these mistakes may be eliminated.

In conclusion, this handy-sized publication supplies a long-felt want for a complete list of the insect fauna affecting Cotton in India, with brief notes on their seasonal and geographical distribution, parasites and predators, and control measures. It may be confidently recommended for reference work to large-scale farmers, Farm Managers and Agricultural Officers working in Cotton tracts to enable them to indentify pests in the initial stages of attack and thereby to initiate control measures by prompt reference to competent authority.

D. SESHAGIRI RAO.

**Endocrines and Constitution in Doves and Pigeons. Publication 572,** By Oscar Riddle, Department of Genetics, Carnegie Institution of Washington, Price $ 3,00 (paper cover). Pp. ix + 306; 1947.

This study deals primarily with the outcome of an attempt to isolate strains or races of ring doves with diverse endocrine-associated traits through choice of 24 pairs of doves (from more than 200 pairs) whose reproductive performance and ancestry were known. Selection sometimes continued for two generations; inbreeding was sustained. Outcrosses provided many hybrid types and also further tests of the heritability of traits. Collection of data from all types was continued during 24 years. Of secondary importance are related results obtained from 12 races of domestic pigeons and from 15 derived hybrid types; from them was developed a race of hermaphrodite producing pigeons. Exceptionally abundant data were obtained on the role of sex, hybridity, and race in heat production.

The primary tests with doves successfully established races with the following traits: With or without sex difference in body weight; small or large thyroids; long or short intestines; high or low response to the hormone prolactin; larger or smaller pituitary glands; early or late sexual maturity in females; larger or smaller eggs; larger or smlller juvenile testes; high or low rate of heat production. Widespread genetic inequalities of individuals and races were thus demonstrated in this material. Most of these results are theoretically applicable to man, and thus provide cogent evidence for biological inequality of human individuals, types, and races.

### Marketing of Fish in Bengal*

We welcome the new series of self-contained *Bulletins* issued by the Royal Asiatic Society of Bengal, whose primary aim, as stated by the Secretary of the Society in his foreword to the first Bulletin, is to furnish a channel of quick publication of suggestions likely to lead to the development of the natural resources of the country. It is appropriate that the first two bulletins, which have now been published, deal with the problems of fisheries which have an all-India interest and importance in augmenting the country's food supplies. Bull. No. 1 is "The Marketing of Fish in London with Comments on the Needs of Calcutta," by S. L. Hora, the former Director of Fisheries, Bengal, and No. 2 is "Suggestions for the Improvement of the Production and Marketing of Fish in Bengal," by T. J. Phillips, Secretary, London Fish Merchants' Association.

Hora gives an account of the fish trade in London and based on this background puts forwrad a scheme for the general improvement of fish trade in Bengal, more particularly Calcutta. His thesis is that, so far, no permanent progress has been made in the supply and marketing of fish in response to reform from the end of the primary producers and that trial should now be made from the other end, namely, marketing of fish in big towns. For this he suggests the setting up of a Central Fish Market for Calcutta, functioning on lines similar to those of the Billingsgate Market in London, which will handle the entire fish trade of Calcutta. In a twenty-years programme of improvement, which he outlines, all attention is to be concentrated on setting up such a Central Market and Cold Storage during the first five years, improvements of facilities for assembling and handling fish to the next five, organizational facilities for procuring and increasing the production of fish to the next five, whereas administrative measures for the management of fisheries are to come during the last five years.

Phillips' paper covers a wider field and he groups his remarks under the heads of (1) Production; (2) Distribution; (3) Marketing; (4) Prices; (5) Selection, Grading, Packing and Preservation; (6) Transport; (7) Cold Storage and (8) Disposal of Waste. He rightly points out that it is of prime importance that production should be increased to the greatest possible extent in the shortest possible time. This is in sharp contrast to Hora's scheme where increased production is to come only in the third five-year phase in spite of the enormous gap between supply and demand,—a gap which according to Hora's own figures for the city of Calcutta gives an average value of about 259 tons of fish per day! Phillips would, therefore, give high priority to the provision of the most up-to-date equipment in the case of marine fisheries and the stocking and management operations of freshwater fisheries. For distribution he advocates a rigid system of licensing of traders combined with a zonal scheme to be drawn up to ensure that each fishing centre would provide the supply of fish for a given adjacent zone, either individually or in groups, thus making it imperative that supplies should be sent from centres only to specified areas. The three phases of marketing, *viz.*, the landing phase, the wholesale market and the retail market are discussed and suggestions are made regarding price grading, packing and preservation for transport and storage. The need for disposal of "condemned fish" is emphasized and in his words "it should be made impossible for any person to obtain possession, for eating purposes, of fish which is unfit for consumption". He strongly disagrees with Hora in his proposal to concentrate upon the organization of the Calcutta Market during the first period of five years leaving the organization of the assembly centres, the organization of the fishermen and promotion of production and other measures to subsequent phases. The following remarks of his are applicable not only to Bengal but to the whole of India. "Whilst having due regard to the fact that the fish industry of Bengal is probably about a thousand years behind the times and that its complete modernization cannot be effected overnight, I would most strongly advise against attempting to remedy the position by concentrating upon one aspect only. In my view it is necessary to adopt a comprehensive policy under which measures would be taken from the outset to promote improvements in production, transport, markets and marketing methods, in conjunction with control of prices and distribution, so that the whole industry might move forward in step. This would, I believe, give a much more solid foundation and substantial improvement should be possible within even the first five years."

In these two Bulletins there is much information of value by way of suggestions which could be followed up with advantage in programmes of fishery development. In our view Hora has overemphasized the need for centralizing fish trade. It is not made clear whether the market envisaged is a Central wholesale market like Billingsgate or a combined wholesale and retail market but, in either case, taking into consideration the tropical conditions under which sales have to take place and the large population to be catered for, the Central Cold Storage cannot effectively serve the retailers and the public without many smaller units distributed in the city. In fact, it may be legitimately asked whether the latter should not have priority over the big Central market. A less ambitious, but perhaps more practicable, programme will be to have adequate and efficient cold storage units for fresh fish, with all attendant improvements, in the different markets scattered about in the city. It should be remembered that the consumer does not live on fish alone and that most people would like to purchase all their requirements from the same shopping area convenient to them. Many municipal corporations in India are now thinking in terms of cold storage for all perishable foods associated with markets; these could have separate fish units and most of Hora's suggestions could be adopted for these smaller units without the drawbacks of overcentralization. In the scheme outlined by

---

* Bulletins Nos. I and II, published by the Royal Asiatic Society of Bengal, Calcutta, 1948.

Phillips, it appears to us that there is a tendency to underrate the practical difficulties in dealing with fishing folk who are not advanced enough to understand and appreciate what is good for them except in terms of immediate cash gain. These remarks are in no way intended to minimise the value of these two stimulating contributions, whose authors have done real service in putting forward their views and have thus provided material for constructive thinking which should help fishery workers to arrive at solutions embodying the best that is practicable in these memoranda.

# SCIENCE NOTES AND NEWS

## Abnormality in the Venous System of *Rana tigrina* (a full-grown specimen)

Mr. D. Vaidyanathan, Biology Department, Bavan's College, Andheri, Bombay, writes:—

In one of the specimens dissected by a student of the Inter Science Class, it was noticed that the *abdominal vein* (anterior abdominal) instead of emptying its contents into the liver abruptly stopped on its way up and found to remain attached to the inner body wall. It was just ¾th the usual length of a full-grown specimen and was full of venous blood. Whether this blood remained stationary in that vessel or it flowed back into the two pelvics (which obviously cannot happen, it being a vein) is a matter which requires explanation. However, in this case, the presence of the abdominal vein does not appear to serve any purpose (I mean taking away a load of venous blood collected from the hind limbs to the heart through the liver) and if this is so, can it be said that its total absence would not cause any hardship to the living animal ?

## Dr. S. L. Hora

In recognition of his "great contributions to tropical zoology" and the "spirit of co-operation and friendship" extended by him to his colleagues abroad, Dr. S. L. Hora has been awarded the Honorary Membership Diploma of "S. Plantentuin". In a communication addressed to Dr. Hora, Dr. L. G. M. Bass Becking, Director, Botanic Gardens, Buitenzörg, declares that "it is really the feeling that scientists in this part of the world should stand together in a solid phalanx, to oppose foolish measures, to combat stupidity and to further speedy reconstruction that prompted us to ask you to accept this nomination".

## Medium of Instruction at University Level

The Ministry of Education, Government of India, have constituted a 26-man Committee to (1) determine the medium of instruction and examination at university level; (2) to determine the placeof English in university education; (3) to consider the stage when English should be replaced by the National or Regional language in secondary or higher education; (4) the question of script and (5) to determine scientific terminology.

## Rhodes Scholarship for India

Rhodes Scholarships were founded at Oxford under the will of Cecil Rhodes to help the students of the dominions and colonies to prosecute studies at Oxford.

The essential attributes of the Rhodes scholar is that he should have physical courage, vigour and an interest in his fellowmen. Two scholarships are allotted to India. Only men are eligible. Candidates are selected from either of the following groups:

Service candidates who must have done at least one year of war service and who were between 19 and 25 years of age between September 1939 and August 1945.

Ordinary candidates between 19 and 25 during October when the universities reopen in U. K.

All candidates must have obtained a first class degree in arts or science of an Indian University. Ordinary candidates must be unmarried.

The scholarships are tenable for two years at Oxford. The third year scholarship may be granted in some cases and candidates may be allowed to work in other universities in U. K.

The scholarships are worth £ 400 (Rs. 5,325).

## Liquid Fuels from Coal

Preparations for the manufacture of one million tons of motor spirit and diesel oil are under way. A batch of technicians has already gone to a colliery in Eastern India for this purpose. This is the result of an agreement concluded recently between the Government of India and an American firm who are experts in carbonising and gasification of coal.

## Telephone Factory

An automatic Telephone Factory, decided to be started by the Ministry of Communications of the Government of India, will be located at Krishnarajapuram, about seven miles from Bangalore. The Government of Mysore are extending all facilities such as water, electric power and an extensive site for the location of the Factory.

## World Cultural Co-operation

The Government of India have formed a committee to determine the constitution of the Indian National Commission, recommended by the UNESCO, in order to work in co-operation on matters of general interest among the member States of the United Nation's Organisation.

## World Congress of Orientalists

The Indian Delegation to the 21st session of the International Congress of Orientalists was led by Sir S. Radhakrishnan, Professor of Eastern Religions and Ethics at Oxford University. The next session of the Congress is expected to be held in New Delhi in 1951.

## World Health Organisation

The Regional Headquarters of the Organisation is to be established at Mysore. The Government of Mysore have agreed to provide all acilities for the location of the Institution.

## Central Institute of Indigenous Medicine

The Government of Mysore have offered the Central Government attractive terms for the location of the Central Research Institute at Bangalore. Bangalore, in addition to its salubrious climate, is one of the foremost centres of scientific research in the country.

## International Congress of Industrial Medicine

The Indian Medical Association has been invited to send representatives on behalf of India to the Ninth Session of the Congress to be held in London between September 13 and 17.

## Congress of Commonwealth Universities

India will be strongly represented at the Congress of the Universities of the Commonwealth, which opens at Oxford on July 19.

It will discuss such vital topics as the relations between the State and the Universities, inter-university relations and reviews, from points of view of the historian, philosopher and sociologist of the structural and moral changes produced in modern society by scientific and technological advance.

The discussions will also cover the balance of research and teaching at universities and general plans for colonial higher education.

UNESCO and other international scholastic organisations and many foreign countries will be represented at the conference which will last for five days.

The Asian representatives will include 24 from Indian universities and colleges, 13 from Pakistan, five from Ceylon, eight from Singapore, two from Hong Kong and one from Burma.

## British Commonwealth of Nations Scientific Liaison Offices B. C. S. O. (London)

The British Commonwealth of Nations Scientific Liaison Offices (London) have been opened on the third floor of Africa House Kingsway, W.C. 2. This is one of the measures to facilitate co-operation in the civil aspects of science within the Commonwealth decided on by the British Commonwealth Scientific Official Conference, held in London in 1946. For a number of years several of the Commonwealth countries have maintained scientific liaison offices in London and these together with the ones about to be established will now have their headquarters in Africa House. Each of these offices will continue to operate as in the past, retaining complete independence of action, but the convenience of occupying adjacent premises will facilitate co-operation between them on matters of common interest. For ease of reference to the group of independent offices as a whole the title given above has been chosen, with the abbreviation B.C.S.O. (London) for common use. The offices taking part in the scheme are the Scientific Liaison Offices of Australia, Canada, Central African Council, India, New Zealand, South Africa and the United Kingdom. Pakistan and the Commonwealth Agricultural Bureaux will be represented and the Overseas Liaison Division of the U.K. Department of Scientific and Industrial Research will work in Africa House.

In Washington the scientific liaison offices of the Commonwealth countries are associated under a similar scheme.

## Tuberculosis Association of India—Annual Report for 1946

The Secretary of the Association in his letter dated 14th July 1948 writes :

With reference to para 4 (page 133) of the Review of our Annual Report for 1946 in your number for April 1948, I am to bring to your notice that the term "D. T. D." as mentioned in our Report is not an error. The Diploma Course instituted by the Delhi University is known as Diploma in Tuberculoris Diseases.

---

### ERRATA

Vol. 17, No. 5, May 1948

Note on "Heat Conductivity and Molecular Weight of Liquids".

Page 148, Col. 1, Para 2, line 16 —
*for* "$K_{B.P.}\sqrt{}$" *read* "$K_{B.P.}\sqrt{M}$"

Vol. 17, No. 5, May 1948

Note entitled "On the Food of the 'Bekti,' *Lates calcarifer* (Bloch)".

Page 157, Col. 1, line 5 *read* (2·15 per cent.) *for* (12·15 per cent.)

Editor: M. Sreenivasaya, B.A., F.I.I.Sc., F.A.Sc.
826-48 Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore

Current Science

Vol. XVII] AUGUST 1948 [No. 8



# THE SCIENCE CO-OPERATION OFFICES OF THE UNESCO

WHEN the United Nations Organisation (UNO) started its activities, it created—or took over from the former League of Nations—a number of so-called specialized agencies, which had to deal with certain particular problems of international importance. One of these agencies is the World Health Organisation (WHO), the task of which is an international campaign against diseases, especially infectious diseases, and epidemics. Another specialized agency is the Food and Agricultural Organisation (FAO), set up to deal with the acute food shortage during and after the war. The United Nations Educational, Scientific and Cultural Organisation (UNESCO) is another of these specialized agencies, which took over the heritage of the Institute International de Co-operation Intellectuelle created by the League of Nations. There is no need to explain the activities of UNESCO in this country where interest is focussed on it and there exist such excellent descriptions of its activities as the booklet published by the Department of Information and Broadcasting of the Government of India.† It suffices to say that the activities of UNESCO being manifold, they are dealt with in various sections within the Secretariat, the headquarters of which is in Paris. One of the sections of UNESCO is devoted to exact and natural sciences and its activities are based on the fact that science and its applied forms (agriculture, medicine, technology, etc.) are playing and will increasingly play an intimate part in all human activities.

Scientific research can make human life healthier, easier, safer and more comfortable (although it can make it more horrible as ever before, too). To ensure that science can freely develop its peaceful aims for the benefit of humanity an international collaboration of scientists and scientific institutions is needed. In our times science cannot be effectively studied individually; scientific research is mainly based on teamwork and a general pooling of the results of man's investigation of nature is essential. Scientific collaboration on international lines is not new discovery. In the XVII century the first academies appointed, from their foundations, foreign secre-

taries to take charge of the correspondence with members of the world community of observers in other countries. But the formal organisation of science internationally was begun only in the XIX century when the custom grew up to hold large "international congresses". Later from these periodically held congresses the system of international unions developed permanent bodies to deal with international problems within a limited subject-matter. These unions are to-day united into an International Council of Scientific Unions and represent an effective tool of international scientific collaboration.

During World War II another type of international scientific collaboration developed. Some of the governments composing the present United Nations set up in one another's capitals "Science Co-operation Offices". The crucial importance of scientific knowledge to the conduct of war made it necessary to ensure that the democratic countries pooled their information. Penicillin, Radar and the Atom Bomb are all cases in point. In contrast to the scientific congresses and the International Unions the wartime science co-operation offices were not confined to any one particular science. But they were bilateral or restricted as to national scope. The largest of these offices during World War II were the British Commonwealth Scientific Office in Washington and the United States Scientific Mission in London. But there were many others, such as the French Scientific Missions in London and Montreal, the Australian Scientific Research Liaison Office in London, the Office of the Australian Scientific Counsellor in Moscow, etc. Most of these were mainly concerned with exchange of information concerning war sciences. There was, however, one such office which dealt not only with war sciences, but with scientific matters concerning agriculture, industry, pure and applied sciences for reconstruction, etc., as well. This was the Sino-British Scientific Office in China (Chungking). From the work of this office and similar other activities arose in the minds of a number of persons more or less simultaneously the realisation of the intense value of chain of such offices in peace time.

UNESCO took up this idea with great enthusiasm. Dr. Needham, who was head of the Sino-British Scientific Office in China during the war, developed in his capacity as head of the Natural Sciences Section of UNESCO a scheme of such offices on an international scale for peaceful purposes. But many others have expressed similar ideas. One of the leading scientists of this country, Dr. (Sir) S. S. Bhatnagar, President of the National Institute of Sciences of India, reached exactly the same conclusions in an article of the booklet of the Department of Information and Broadcasting mentioned above ("Science and International Co-operation", page 27 ff.). His idea of "regional scientific co-operation stations" corresponds in all details to the Science Co-operation Offices (sometimes called *Field* Science Co-operation Offices to denote their regional character) of UNESCO. The great value of this type of international scientific co-operation in addition to the activities of the International Unions is obvious. The Unions are not limited by country, but they are limited as to subject-matter. The Offices are not limited by subject-matter but their activities are devoted to that part of the world in which they happen to be. Thus the two systems of international scientific co-operation complete each other in a most fortunate manner.

UNESCO has a formal agreement with the International Council of Scientific Unions by which it will be able to promote their activities (and has already substantially done so, supporting international congresses, paying for their publications, etc.). In 1947 it began to establish a system of science co-operation offices, in various regions. It started with three offices, in Riode Janeiro (for Latin America), in Cairo (for the Middle East) and in Nanking (for the Far East). The fourth office has just recently been opened in this country (as reported in "*Current Science*," May issue, page 169), following the urgent appeal of India's delegates at the last General Conference of UNESCO.

The Office is provisionally lodged in the Science Buildings of the University of Delhi, the authorities of which have shown a really cordial spirit of help and understanding. This gesture is most encouraging for the future activities of the Office which will depend to a great extent on the support and readiness to co-operate of the scientists and scientific institutions of this country. The question of finding definite lodgings and the possibility of establishing some branch-offices in great scientific centres of South Asia are still under consideration.

Finally, a few words may be said about the proposed activities of the Science Co-operation Office of UNESCO in this country and other parts of South Asia. One of the first aims is

to establish and maintain personal contacts and cordial relations with government departments concerned with science and with scientific societies, university faculties, research institutions and associations as well as with individual scientists and technologists of the countries of the region. Furthermore, the Office wishes to act as a clearing house and information centre for the supply and distribution of scientific literature, essential scientific equipment and material, ensuring that they reach the proper recipients. Even unpublished data and raw ideas and suggestions should be supplied and distributed whenever possible. The office wishes to assist with all problems of scientific documentation, *e.g.*, translations, abstracts, microfilms, reprints, etc. It wishes to facilitate the outward flow of scientific and technical reports from laboratories and other sources as well as scientific journals. From time to time the Office will inform the scientific world about interesting work being carried out in the subcontinent. A further aim is to arrange the exchange of scientific correspondence and manuscripts, scientific papers, articles and reviews for publication. A scientist once said, "A scientific post office requires the qualities of a 'department of insufficient addresses' for its aim should be to ensure that every communication reaches its proper destination, a destination which the author himself may only vaguely know." The Science Co-operation Office of UNESCO wishes to be such a post office too. It will also assist in the exchange of persons by making suggestions for travel grants to UNESCO or to the International Unions, as far as such grants are available. Of course, the Office will collaborate with bilateral scientific missions and scientific attaches within the region and will co-operate with and advise when possible other specialized agencies of the United Nations, such as FAO, or WHO. The Office will also assist, whenever possible, in the exploration of the possibilities of the foundation of international scientific laboratories and observatories in the region. (For South Asia, at the moment, projects of an International Institute of Fisheries on the shores of the Indian Ocean, the internationalization of some of the Indonesian research institutions and as a later scheme the establishment of an International High Altitude Research Institute on the slopes of the Himalayas are under consideration.) Assistance will be given in the study of the feasibility of international stock-rooms, *e.g.*, pure chemicals, new materials, radioactive isotopes, type-cultures, pure line strains of laboratory elements and of plants, etc. Finally, an important aim is to assist in the compilation of a world register of scientific institutions and scientists.

There are several means by which these aims and tasks may be realized. But the most important of them is the active help and willingness to co-operate of all the scientists and scientific institutions mentioned above. If this will be granted, the UNESCO's Science Co-operation Offices will be able to do their share in bringing scientists of the world closer together, and by this aiding the maintenance of peace and improvements of living conditions of the peoples of the world.

---

†"*UNESCO*" Modern India Series, I, 1946.

---

## INDIAN JOURNAL OF DAIRY SCIENCE

We have received a copy of the two numbers (March and June) of the *Indian Journal of Dairy Science*, the official organ of the Indian Dairy Science Association. This quarterly according to the Editor, is "the outcome of a long-felt desire on the part of all persons concerned with Dairy Science in India to find a satisfactory medium of expression to cover the large and growing developments in the science and practice of dairying in this country and to serve as a link between scientific workers engaged in different parts of the world."

The issue contains six original contributions on various aspects of Dairy Research, *viz.*, Studies on Cotton Seed Feeding to Milch Animals, Composition of Milk Fat of Various Species of Animals, Phosphatases in Milk, Comparative Study of the Ten Minutes' Resazurin Test, Storage of Indigenous Butter and Studies on Vagetable Rennets. Some of the articles, however, do not appear to have received the same degree of editorial scrutiny as the rest.

The get-up of the Journal, considering the present conditions of printing in this country, should be regarded as excellent. We wish the Journal an eventful and uninterrupted career in the service of the pure and applied aspects of Dairy Science.

# ORGANISATION AND WORK OF THE CAVENDISH LABORATORY*

SIR LAWRENCE BRAGG, O.B.E., F.R.S.

THE Cavendish Laboratory is faced with problems which are common to most scientific laboratories in this post-war period, and arise from the great expansion in the numbers of undergraduate and graduate students. Part of this increase is a temporary phenomenon. Men are being released from the Forces who have missed the whole or part of their undergraduate time at the university, and are returning to swell the classes. The increase in the first- and second-year students at Cambridge is perhaps not as great as it is in other universities, because the undergraduate population is limited by college accommodation; in physics these classes at present are some 50 per cent. greater than they were before the War. The numbers in the final honours class, however, have almost trebled, because men returning from war-work for the most part join this class, which now has about a hundred and twenty students. It will probably remain considerably higher than its pre-war level, because the recommendations of the Barlow Report reflect the need of the nation for more scientists, and demand is creating a supply. The greatest increase of all is in the number of research students, and here the Laboratory is crowded to capacity, if not overcrowded. Although all available places are used. the number of those who apply for admission as research students is three or four times as great as the number which can be accepted each year. More than a hundred and sixty researchers are now working in the Laboratory, of whom 110 are research students working for their Ph.D. degrees—between one-fifth and one-sixth of the total number registered for research degrees in Cambridge.

This large increase implies a major change in the organisation of the Laboratory. The old days when the head of the department could be in close contact with all his research students are a matter of the past. There would appear to be a limit in organisations of all kinds to the number of men whom any one head can direct by close personal contact, this number being about six. It applies in the direction of research as well, and devolving of responsibility is essential when numbers rise above this *limit*. Even before the War, numbers of researchers in the larger laboratories were approaching the $6^2$ level, and now they are in the $6^3$ region. In other words, the organisation of the research work involves splitting up the men into large groups under leaders, and these again into smaller groups, so that the head of the department is two removes from the researcher himself. Except in a few special cases of work in which he is particularly interested, he cannot afford to spend that two or three-hour period every fortnight or so talking over his work with the individual, which is essential for real direction.

The major groups in the Cavendish Laboratory are nuclear, radio and low-temperature physics, crystallography, metal physics and mathematical physics, with some minor groupings. It may be interesting to give some account of the extent to which these groups are independent, and of the common ground on which they meet. The great foe of research is administrative responsibility. A nice adjustment has to be made between giving the heads of groups as much freedom as possible to make their plans for using their facilities to the best advantage, and at the same time relieving them of the more tiresome and mechanical details of administration which can be properly centralized. In our organisation each group has its own allocation of the budget for the year, and its own order-book, so that apparatus and supplies can be bought within that budget; each has its own staff of assistants and its workshop; it has its own secretary for clerical work; further, each group runs its own colloquium, where scientific papers from other laboratories are discussed and the researchers give reports of their progress. The days are past when most researches in a department were on closely related lines and a joint colloquium was possible. A colloquium in one group or another is now an almost daily event, and no individual can spare the time to go to them all. Common touch is kept up by the fortnightly meetings of the Cavendish Physical Society, where the heads of the groups give an account of the work going on in their sections, and distinguished visitors speak, and by more informal meetings of the leading researchers, such as the little club which was founded by Kapitza when he was head of the Mond Laboratory.

The administrative burden of the teaching staff has been much lightened by the appointment by the University of a secretary to the Laboratory. This officer has in his charge finance, appointments of assistant staff and rates of pay, the formal work concerned with admissions, structural alterations and upkeep of the buildings, preparation of agenda for meetings, and other matters of this kind.

A main workshop serves all sections of the Laboratory, where work requiring special tools and skills is carried out; glass-blowing is also centralized. There is also a separate central workshop where research students can use the machine tools, where the young assistants are trained, and where repairs to class-apparatus are carried out. In addition, two special centres deserve mention. It has been found convenient to have a 'special techniques' workshop where the most highly skilled and delicate work of especial kinds is carried out, and to place this workshop in charge of a member of the staff. It is largely concerned with the construction and sealing of Geiger counters, and the purification of the gases with which they are filled. Special thermionic devices are made there, and evacuated, baked and sealed. It manufactures delicate metal parts by a photographic technique, such

* From a course of three lectures at the Royal Institution on March 4, 11 and 18.

as supports for thin-walled windows, makes special metal-to-glass or metal-to-silica joints, and has apparatus for preparing thin metal films by evaporation. The other centre, also in charge of a member of the staff, constructs and maintains electronic equipment of all kinds, such as decimal scalers and multiple coincidence circuits, or pulse and D.C. amplifiers for nuclear work. The capital value of the electronic equipment of this kind approaches five figures, and it is a saving of time and money to place it in charge of an expert.

The largest group in the laboratory is the nuclear physics group, under Prof. O. R. Frisch and Mr. E. S. Shire, with some forty researchers. The Cambridge equipment includes the one-million and two-million volt sets in the high tension laboratory, and a cyclotron with 37-in. pole-pieces. A five million volt Van de Graaff generator is being built for the Laboratory by the English Electric Company, and it is hoped to get it running by the end of 1948. The maintenance of this large and complex units introduces problems of a new scale in a physics laboratory. It creates the need for a new type of staff member, the 'Technical Officer'. He must be a trained physicist, in general a University Graduate, but a man who has the engineer's outlook and who is interested in the construction and functioning of the apparatus rather than in the research which is done with it.

The radio group represents the continuation in the Laboratory of the work which Sir Edward Appleton started when he occupied the Jacksonian Chair at Cambridge; it is now under the direction of Mr. J. A. Ratcliffe. It has field stations as well as its section of the main Laboratory. The work on propagation is mainly concerned with the longer wavelengths which are reflected below the E-layer. Another section is making measurements of the waves in the metre wave-length region coming from the sun, recording their intensity and propagation and estimating the size of the source from which they come by a method analogous to Michelson's method of measuring the angular diameter of a star.

The Mond Laboratory is now under the direction of Dr. D. Shoenberg, its former head, Dr. J. F. Allen having been recently appointed to St. Andrews. A main interest is the properties of superconductors, in particular the penetration of magnetic fields into superconductors. It has equipment for the magnetic method of cooling. Liquid helium is at present made by Kapitza's expansion machine; but a new machine of greater capacity and more orthodox type is under construction.

In crystallography, under Dr. W. H. Taylor, the arrangement of atoms in minerals, alloys, organic compounds and proteins is being studied. The section studying proteins under Dr. M. F. Perutz and J. C. Kendrew has this year been accorded the backing of the Medical Research Council. The elucidation of the structure of such enormous and complex molecules is the most ambitious problem as yet tackled by X-ray analysis, and success would cast a flood of light on the structure of living matter.

The metal physics section, under Dr. E. Orowan, is concerned with problems of slip and plasticity, fracture, crystal growth, and metallic phenomena in general investigated by physical methods.

The Laboratory houses an electron microscope service which is used by all departments of the University. It provides hospitality for several researchers from other departments. Particularly welcome guests are the mathematical physicists, including the Plummer Professor, D. R. Hartree, who have rooms in the Laboratory.

It may be of interest to assess in round figures the cost of research in the Cavendish Laboratory. The figures must be approximate, since many of the services are common to teaching and research. As an example, in the following estimate the time of the University staff is regarded as divided equally between teaching and research, and its cost apportioned accordingly. Making similar adjustments for administration, assistant staff, stores and apparatus (almost entirely research) and so forth, the total expenditure on research in the Laboratory (including the Mond) was just short of £ 60,000 in 1946-47, of which £ 10,000 came from outside sources. To this must be added a sum to represent the rental of the buildings, which does not appear in the estimates. In estimating the cost per research student, the abnormal position of nuclear research must be taken into account. Not only are the running expenses above the average, but also units such as the cyclotron represent a large outlay of capital, and special grants are made by the Department of Scientific and Industrial Research to meet needs which the University cannot finance from its own resources. Such requirements vary very greatly from year to year, and I have therefore only included a sum for nuclear research which corresponds to the expenditure per researcher in other branches of physics, and which roughly represents the contribution which the University itself makes towards the cost of the nuclear research. On this basis, the cost per research student is £ 400 a year. If to this is added £ 350 to represent the average maintenance grant of junior and senior workers, the total cost to the state of maintaining a research worker in the Cavendish Laboratory is £ 750 a year.

## EXCHANGE OF SCIENTIFIC KNOWLEDGE—AUSTRALIA AND IN

THE Australian Goodwill Scientific Mission which, visited has recommended that a party of Indian scientists be invited to visit Australia.

At a later date, when conditions are more normal, it is expected that students from there may be afforded facilities to carry out post-graduate work in Australia, and that an exchange of workers between the Council for Scientific and Industrial Research in Australia and the Council for Scientific and Industrial Research of India may be arranged.

In the course of a report which the Australian mission has issued, it is stated that all Indian universities evince "considerable interest in Australian universities and student life. Members of the delegation are stated to have received a large number of enquiries from Indian students about the possibility of undertaking work, particularly post-graduate study, in Australian universities. The report adds that many Indians are thinking of Australia as a place for post-graduate training in addition to Europe and America.

"The various difficulties Australian universities would experience at present in accommodating Indian students, due to over-crowded post-war conditions, were explained enquirers. Nevertheless, it is apparei a demand is likely to arise from Ind study in Australia, and the delegatio that when conditions become more norn should be encouraged.

"It is also possible that there are scientist in India, for example, Sir C. V. at the Indian Institute of Science, and Pr P. C. Mahalanobis, the Director of the tute of Statistics at Calcutta, under Australians might wish to study.

"The exchange of students at an impr able age would be very useful in builc goodwill between the two countries", port continued. "Members of Indian sity staffs also enquired about the pos of visiting Australia for short peric lecturing or research purposes and ab possibility of arranging exchanges detailed method of carrying out such tions would involve many difficulties, is felt that everything should be d encourage exchange wherever possible. is no doubt that in the academic worlc looking to Australia as a friend."

---

## SCIENTISTS ARE BORN AND NOT MADE

CAPACITY for creative thinking is a relatively rare inborn talent. Under proper environmental stimulation, it develops that quality of mind essential in original research. Advances in science will depend upon discovering this talent and putting it to work. The need for doing this is well recognised to be in the national interest and is giving rise to the appropriation of vast federal funds for research and legislation toward the establishment of a National Science Foundation. These measures, valuable as they can be in encouraging the development of scientific ability, cannot create scientists. From the overcrowded graduate schools come hundreds each year with the doctorate in chemistry and other sciences. Yet the great majority of these young Ph. D.'s have no real abiility in original thinking! Learned, proficient, and skilled they may be in experimental techniques, but these are not substitutes for intelligence and the capacity to have ideas.

It is evident that the first and most important step toward increasing the yield of men qualified for research is to seek out and recognise the essential talent when it appears. Graduate school need to become more discriminating in their acceptance of candidates for the doctoral degree and more cou in rejecting those lacking the quali Too often the persistent attain what o giftted deserve. By the assignment lems requiring the exercise of research early in the first year of graduate should be possible to discern latent ab it exists. Those who display defini dence of research capacity should admitted to what might be called the " graduate school and go on for the do The present emphasis in graduate trai course work and doctoral thesis often allow sufficient opportunity for trai and practice of research methods. A sequence, men enter research careers familiarity with the research appro problems.

It is not more graduate school capaci is needed today but better selection who are to be trained. Men possessing city for creative thinking deserve attention of graduate faculties and facilities. Society will be the ben when this comes about.

(By courtesy of The Journal of the chemical Society, 93, 53N, 1948.)

---

## PROCUREMENT OF RADIOACTIVE ISOTOPES

IT has been decided that all matters connected with the procurement of radioactive isotopes are to be handled in India by the Board of Research on Atomic Energy in consultation with the Department of Scientific Research. Requests for the procurement from abroad of radioactive isotopes or any information relating to Atomic Energy should there addressed to the Department of S Research who will forward them after through the appropriate channels. Requ dressed directly to foreign governments representatives in India are not likel acted upon.

# LETTERS TO THE EDITOR



## A CHALLENGE TO MATHEMATICIANS

HERE is a problem which I wish to offer as a challenge to mathematicians, especially those who deem themselves so superior that they will not touch anything in elementary mathematics even with a broken rod. But the great mathematical philosopher, A. N. Whitehead, has said that elementary mathematics is one of the most characteristic creations of modern thought by virtue of the intimate way in which it correlates theory and practice. I now come to my problem for which I require a strictly *non-visual proof*, a proof which should make the least appeal to intuitive relations perceived by the physical eye.

*Problem:* Two intersecting straight lines (or planes) and a point not incident on either of them are taken in a plane (or space). Show that the line joining the feet of the perpendiculars from the point to the straight lines (or planes) subtends at the given point an angle which is always the supplement of that angle between the two straight lines (or planes) in which the given point lies.

If a figure is drawn or a model is prepared, the property becomes visually evident but real mathematics does not and should not seek the help of the eyes of the body but the eye of the mind. An algebraic identity is not true because you can write it down and see it.

Will mathematicians take interest in the above little problem which is very useful in settling angular ambiguities which teachers glibly pass over in their routine teaching?

Mysore, A. A. K.
*July* 30, 1948.

## EFFECT OF INCREASING FREQUENCIES ON THE ULTRASONIC DIFFRACTION PATTERNS

DAVID,[1] basing himself on Brillouin's work, has developed a theory which leads to the following expression for I ±, the intensity of the +1 or −1 order diffraction line in the case of normal incidence.

$$I_{\pm} = I_m \cdot \left[ \frac{\sin \frac{\pi\lambda L}{2\mu_0\lambda^{*2}}}{\frac{\pi\lambda L}{2\mu_0\lambda^{*2}}} \right]^2$$

$\lambda$ is the wavelength in vacuum of light that is being diffracted, $\lambda^*$ is the wavelength of sound or the grating element in the liquid, $\mu_0$ is its refractive index and L is the length of the sound field. $I_m$ stands for the maximum intensity of this line, which occurs when the obliquity of the sound wave front is such that the diffracted ray is emerging in a direction which corresponds exactly to that of Bragg reflection. This condition is attained for the first order lines when the tilt angle $\theta$ is $\sin^{-1} \lambda/2\mu_0\lambda^*$. It is easily seen from the above ex-

## EXCHANGE OF SCIENTIFIC KNOWLEDGE—AUSTRALIA AND INDIA

THE Australian Goodwill Scientific Mission which visited has recommended that a party of Indian scientists be invited to visit Australia.

At a later date, when conditions are more normal, it is expected that students from there may be afforded facilities to carry out post-graduate work in Australia, and that an exchange of workers between the Council for Scientific and Industrial Research in Australia and the Council for Scientific and Industrial Research of India may be arranged.

In the course of a report which the Australian mission has issued, it is stated that all Indian universities evince "considerable interest in Australian universities and student life. Members of the delegation are stated to have received a large number of enquiries from Indian students about the possibility of undertaking work, particularly post-graduate study, in Australian universities. The report adds that many Indians are thinking of Australia as a place for post-graduate training in addition to Europe and America.

"The various difficulties Australian universities would experience at present in accommodating Indian students, due to over-crowded post-war conditions, were explained to the enquirers. Nevertheless, it is apparent that a demand is likely to arise from Indians to study in Australia, and the delegation feels that when conditions become more normal this should be encouraged.

"It is also possible that there are certain scientist in India, for example, Sir C. V. Raman at the Indian Institute of Science, and Professor P. C. Mahalanobis, the Director of the Institute of Statistics at Calcutta, under whom Australians might wish to study.

"The exchange of students at an impressionable age would be very useful in building up goodwill between the two countries", the report continued. "Members of Indian University staffs also enquired about the possibility of visiting Australia for short periods for lecturing or research purposes and about the possibility of arranging exchanges. The detailed method of carrying out such suggestions would involve many difficulties, but it is felt that everything should be done to encourage exchange wherever possible. There is no doubt that in the academic world India is looking to Australia as a friend."

## SCIENTISTS ARE BORN AND NOT MADE

CAPACITY for creative thinking is a relatively rare inborn talent. Under proper environmental stimulation, it develops that quality of mind essential in original research. Advances in science will depend upon discovering this talent and putting it to work. The need for doing this is well recognised to be in the national interest and is giving rise to the appropriation of vast federal funds for research and legislation toward the establishment of a National Science Foundation. These measures, valuable as they can be in encouraging the development of scientific ability, cannot create scientists. From the overcrowded graduate schools come hundreds each year with the doctorate in chemistry and other sciences. Yet the great majority of these young Ph. D.'s have no real abiility in original thinking! Learned, proficient, and skilled they may be in experimental techniques, but these are not substitutes for intelligence and the capacity to have ideas.

It is evident that the first and most important step toward increasing the yield of men qualified for research is to seek out and recognise the essential talent when it appears. Graduate school need to become more discriminating in their acceptance of candidates for the doctoral degree and more courageous in rejecting those lacking the qualification. Too often the persistent attain what only the giftted deserve. By the assignment of problems requiring the exercise of research talent early in the first year of graduate work, it should be possible to discern latent ability if it exists. Those who display definite evidence of research capacity should then be admitted to what might be called the "higher" graduate school and go on for the doctorate. The present emphasis in graduate training on course work and doctoral thesis often fails to allow sufficient opportunity for training in and practice of research methods. As a consequence, men enter research careers lacking familiarity with the research approach to problems.

It is not more graduate school capacity that is needed today but better selection of those who are to be trained. Men possessing capacity for creative thinking deserve the full attention of graduate faculties and school facilities. Society will be the beneficiary when this comes about.

(By courtesy of The Journal of the Electrochemical Society, 93, 53N, 1948.)

## PROCUREMENT OF RADIOACTIVE ISOTOPES

IT has been decided that all matters connected with the procurement of radioactive isotopes are to be handled in India by the Board of Research on Atomic Energy in consultation with the Department of Scientific Research. Requests for the procurement from abroad of radioactive isotopes or any information relating to Atomic Energy should therefore be addressed to the Department of Scientific Research who will forward them after scrutiny through the appropriate channels. Requests addressed directly to foreign governments or their representatives in India are not likely to be acted upon.

# LETTERS TO THE EDITOR



## A CHALLENGE TO MATHEMATICIANS

HERE is a problem which I wish to offer as a challenge to mathematicians, especially those who deem themselves so superior that they will not touch anything in elementary mathematics even with a broken rod. But the great mathematical philosopher, A. N. Whitehead, has said that elementary mathematics is one of the most characteristic creations of modern thought by virtue of the intimate way in which it correlates theory and practice. I now come to my problem for which I require a strictly *non-visual proof*, a proof which should make the least appeal to intuitive relations perceived by the physical eye.

*Problem:* Two intersecting straight lines (or planes) and a point not incident on either of them are taken in a plane (or space). Show that the line joining the feet of the perpendiculars from the point to the straight lines (or planes) subtends at the given point an angle which is always the supplement of that angle between the two straight lines (or planes) in which the given point lies.

If a figure is drawn or a model is prepared, the property becomes visually evident but real mathematics does not and should not seek the help of the eyes of the body but the eye of the mind. An algebraic identity is not true because you can write it down and see it.

Will mathematicians take interest in the above little problem which is very useful in settling angular ambiguities which teachers glibly pass over in their routine teaching?

Mysore, A. A. K.
*July* 30, 1948.

## EFFECT OF INCREASING FREQUENCIES ON THE ULTRASONIC DIFFRACTION PATTERNS

DAVID,[1] basing himself on Brillouin's work, has developed a theory which leads to the following expression for $I_\pm$, the intensity of the +1 or −1 order diffraction line in the case of normal incidence.

$$I_\pm = I_m \cdot \left[\frac{\sin \dfrac{\pi\lambda L}{2\mu_0\lambda^{*2}}}{\dfrac{\pi\lambda L}{2\mu_0\lambda^{*2}}}\right]^2$$

$\lambda$ is the wavelength in vacuum of light that is being diffracted, $\lambda^*$ is the wavelength of sound or the grating element in the liquid, $\mu_0$ is its refractive index and L is the length of the sound field. $I_m$ stands for the maximum intensity of this line, which occurs when the obliquity of the sound wave front is such that the diffracted ray is emerging in a direction which corresponds exactly to that of Bragg reflection. This condition is attained for the first order lines when the tilt angle $\theta$ is $\sin^{-1} \lambda/2\mu_0\lambda^*$. It is easily seen from the above ex-

## EXCHANGE OF SCIENTIFIC KNOWLEDGE—AUSTRALIA AND INDIA

THE Australian Goodwill Scientific Mission which visited has recommended that a party of Indian scientists be invited to visit Australia.

At a later date, when conditions are more normal, it is expected that students from there may be afforded facilities to carry out post-graduate work in Australia, and that an exchange of workers between the Council for Scientific and Industrial Research in Australia and the Council for Scientific and Industrial Research of India may be arranged.

In the course of a report which the Australian mission has issued, it is stated that all Indian universities evince "considerable interest in Australian universities and student life. Members of the delegation are stated to have received a large number of enquiries from Indian students about the possibility of undertaking work, particularly post-graduate study, in Australian universities. The report adds that many Indians are thinking of Australia as a place for post-graduate training in addition to Europe and America.

"The various difficulties Australian universities would experience at present in accommodating Indian students, due to over-crowded post-war conditions, were explained to the enquirers. Nevertheless, it is apparent that a demand is likely to arise from Indians to study in Australia, and the delegation feels that when conditions become more normal this should be encouraged.

"It is also possible that there are certain scientist in India, for example, Sir C. V. Raman at the Indian Institute of Science, and Professor P. C. Mahalanobis, the Director of the Institute of Statistics at Calcutta, under whom Australians might wish to study.

"The exchange of students at an impressionable age would be very useful in building up goodwill between the two countries", the report continued. "Members of Indian University staffs also enquired about the possibility of visiting Australia for short periods for lecturing or research purposes and about the possibility of arranging exchanges. The detailed method of carrying out such suggestions would involve many difficulties, but it is felt that everything should be done to encourage exchange wherever possible. There is no doubt that in the academic world India looking to Australia as a friend."

## SCIENTISTS ARE BORN AND NOT MADE

CAPACITY for creative thinking is a relatively rare inborn talent. Under proper environmental stimulation, it develops that quality of mind essential in original research. Advances in science will depend upon discovering this talent and putting it to work. The need for doing this is well recognised to be in the national interest and is giving rise to the appropriation of vast federal funds for research and legislation toward the establishment of a National Science Foundation. These measures, valuable as they can be in encouraging the development of scientific ability, cannot create scientists. From the overcrowded graduate schools come hundreds each year with the doctorate in chemistry and other sciences. Yet tehe great majority of these young Ph. D.'s have no real abiility in original thinking! Learned, proficient, and skilled they may be in experimental techniques, but these are not substitutes for intelligence and the capacity to have ideas.

It is evident that the first and most important step toward increasing the yield of men qualified for research is to seek out and recognise the essential talent when it appears. Graduate school need to become more discriminating in their acceptance of candidates for the doctoral degree and more courageous in rejecting those lacking the qualification. Too often the persistent attain what only the giftted deserve. By the assignment of problems requiring the exercise of research talent early in the first year of graduate work, it should be possible to discern latent ability if it exists. Those who display definite evidence of research capacity should then be admitted to what might be called the "higher" graduate school and go on for the doctorate. The present emphasis in graduate training on course work and doctoral thesis often fails to allow sufficient opportunity for training in and practice of research methods. As a consequence, men enter research careers lacking familiarity with the research approach to problems.

It is not more graduate school capacity that is needed today but better selection of those who are to be trained. Men possessing capacity for creative thinking deserve the full attention of graduate faculties and school facilities. Society will be the beneficiary when this comes about.

(By courtesy of The Journal of the Electrochemical Society, 93, 53N, 1948.)

## PROCUREMENT OF RADIOACTIVE ISOTOPES

IT has been decided that all matters connected with the procurement of radioactive isotopes are to be handled in India by the Board of Research on Atomic Energy in consultation with the Department of Scientific Research. Requests for the procurement from abroad of radioactive isotopes or any information relating to Atomic Energy should therefore be addressed to the Department of Scientific Research who will forward them after scrutiny through the appropriate channels. Requests addressed directly to foreign governments or their representatives in India are not likely to be acted upon.

# LETTERS TO THE EDITOR



## A CHALLENGE TO MATHEMATICIANS

HERE is a problem which I wish to offer as a challenge to mathematicians, especially those who deem themselves so superior that they will not touch anything in elementary mathematics even with a broken rod. But the great mathematical philosopher, A. N. Whitehead, has said that elementary mathematics is one of the most characteristic creations of modern thought by virtue of the intimate way in which it correlates theory and practice. I now come to my problem for which I require a strictly *non-visual proof*, a proof which should make the least appeal to intuitive relations perceived by the physical eye.

*Problem:* Two intersecting straight lines (or planes) and a point not incident on either of them are taken in a plane (or space). Show that the line joining the feet of the perpendiculars from the point to the straight lines (or planes) subtends at the given point an angle which is always the supplement of that angle between the two straight lines (or planes) in which the given point lies.

If a figure is drawn or a model is prepared, the property becomes visually evident but real mathematics does not and should not seek the help of the eyes of the body but the eye of the mind. An algebraic identity is not true because you can write it down and see it.

Will mathematicians take interest in the above little problem which is very useful in settling angular ambiguities which teachers glibly pass over in their routine teaching?

Mysore, A. A. K.
*July* 30, 1948.

## EFFECT OF INCREASING FREQUENCIES ON THE ULTRASONIC DIFFRACTION PATTERNS

DAVID,[1] basing himself on Brillouin's work, has developed a theory which leads to the following expression for $I_\pm$, the intensity of the +1 or −1 order diffraction line in the case of normal incidence.

$$I_\pm = I_m \cdot \left[\frac{\sin \dfrac{\pi\lambda L}{2\mu_0\lambda^{*2}}}{\dfrac{\pi\lambda L}{2\mu_0\lambda^{*2}}}\right]^2$$

$\lambda$ is the wavelength in vacuum of light that is being diffracted, $\lambda^*$ is the wavelength of sound or the grating element in the liquid, $\mu_0$ is its refractive index and L is the length of the sound field. $I_m$ stands for the maximum intensity of this line, which occurs when the obliquity of the sound wave front is such that the diffracted ray is emerging in a direction which corresponds exactly to that of Bragg reflection. This condition is attained for the first order lines when the tilt angle $\theta$ is $\sin^{-1} \lambda/2\mu_0\lambda^*$. It is easily seen from the above ex-

pression that for a given $\lambda$, L and $\mu_0$; increasing sound frequency which means a decreasing value of $\lambda^*$ will result in a rapidly diminishing value for $I\pm$ because the numerator within the brackets never exceeds unity while the denominator, containing $\lambda^*$ in its fourth power, goes on increasing. Thus the angular range in which the diffraction lines persist goes on diminishing, the lines themselves being steadily weakened in the normal incidence position until they disappear altogether for the first time when $\lambda^*$ is such that the relation $\lambda L/2\mu_0\lambda^{*2}=1$ is satisfied. This is an important result. A revival of intensity for still lower values of $\lambda^*$ is indicated but this will be so small that lines, if they reappear, will be of very feeble intensity. They will again disappear when $\lambda L/2\mu_0\lambda^{*2}=2$ and thereafter it should be extremely difficult to observe the patterns at all.

The same result may be obtained in a different manner. Raman and Nagendra Nath,[2] starting from very simple considerations, concluded that the diffraction effects will periodically disappear, as the obliquity $\theta$ of the sound wave front from the position of normal incidence takes values successively equal to $\tan^{-1}n\lambda^*/L$ with $n=\pm 1, \pm 2, \pm 3$ and so on, $n=0$ being excluded. This is due to the fact that a plane light wave front entering the liquid under such conditions emerges without any corrugations in it. It is obvious that such a destructive effect will take its full toll of the diffraction pattern if it occurs for the first time at an obliquity which is the same as would otherwise have given rise to a maximum intensity for the first order diffraction line. In other words, if $\lambda^*$ has become low enough to satisfy the condition $\tan^{-1}\lambda^*/L=\sin^{-1}\lambda/2\mu_0\lambda^*$, there will appear no diffraction spectra even in favoured positions, not to speak of normal incidence. If we are dealing with small angles the above condition reduces to $\lambda L/2\mu_0\lambda^{*2}=1$, In practice, however, there may be small. remnant intensities in narrow angular ranges roundabout the appropriate obliquities. As in the previous case, a feeble revival of intensity is indicated for still smaller values of $\lambda^*$, but conditions favourable for total destructive interference again occur when $2\lambda^*/L=\lambda/2\mu_0\lambda^*$ which is the same $\lambda L/2\mu_0\lambda^{*2}=2$. Thereafter it should be extremely difficult to observe the patterns at all.

For $\lambda=5400\times10^{-8}$ cm.; $L=8$ mm.; $\mu_0=1{\cdot}333$; $\lambda^*$ satisfying the above conditions comes out as 0·004 cm. and 0·0028 cm. corresponding to frequencies of 37 and 53 Mcs/sec. in water. Experiments, specially designed to cover the high frequency regions, have yielded results which are in agreement with the above conclusions. At 50 Mcs./sec., the first order diffraction lines in water could be recorded faintly in normal incidence. In that position, they are not obtained at all, if sound frequencies in the range 100 to 200 Mcs./sec. are used.[3]

Andhra University, Waltair, *July* 27, 1948. S. BHAGAVANTAM.

1. *Physikal. Z.*, 1937, **38**, 587. 2. *Proc. Ind. Acad. Sci.*, 1935, **2**, 413. 3. *Nature*, 1948, **161**, 927.

## THE ELECTROLYTIC PREPARATION OF ROCCELIN

THE electrolytic preparation of azo-dyes was first carried out by Löb.[1] Löb claimed to have prepared, by electrolysing molar proportions of an amine, a suitable coupling component, usually a phenol, and sodium nitrite in a neutral or alkaline medium at a platinum anode with vigorous stirring, the dyes Roccelin, Orange II, Congo red, Chrysamine G and Di-anisidine blue. Löb does not give experimental details or yields or describe the quality of the dyes prepared by this method. Brockman and Griffin[2] confirm Löb's results so far as the dyes Roccelin and Orange II are concerned but report that they were unable to prepare Congo red and Chrysamine G as claimed by Löb. Brockman and Griffin state the yield of the dye Roccelin to have been quantitative with over 95% current efficiency.

This claim is open to doubt, in view of the mechanism proposed for the reaction. Löb, who discovered the reaction, suggested that it took the following course:

$$NO_2^- \rightarrow NO_2 + e$$
$$R.NH_2 + NO_2^- \rightarrow R.N_2.OH + OH^-$$

The diazo-compound would then couple in the usual way with the phenol or other coupling component to give the dye.

Glasstone, in a review[3], proposes a somewhat different course:

$$NO_2^- + H_2O \rightleftharpoons HNO_2 + OH^- \qquad (1)$$

and
$$2\,NO_2 + H_2O \rightarrow 2HNO_2 + \tfrac{1}{2}O_2 \qquad (2)$$

followed by
$$R.NH_2 + HNO_2 \rightarrow R.N_2.OH + H_2O \qquad (3)$$

Though this is not stated by Glasstone, Eq. 2 evidently involves the action of discharged nitrite ions. It will be seen that in either scheme of reaction the discharge of nitrite ions is a necessary step in the formation of the diazo-compound. However, the reaction can be carried out only in a neutral or alkaline medium, for obvious reasons. The reaction represented by Eq. 1 in Glasstone's scheme would be shifted to the left in an alkaline solution, and at the same time, hydroxyl ion discharge is likely to predominate over nitrite ion discharge at the anode, on account of the very high mobility of the hydroxyl ion and its lower discharge potential. The first stage of the reaction, that is the diazotisation of the amine, can therefore never take place with 100% current efficiency in any event. Apart from this, the second stage, namely the coupling of the diazo-compound with the coupling component depends both on the rate of diazotisation of the amine and on the alkalinity of the reaction medium.[4] When a naphthol is the coupling component, the medium is generally kept alkaline though not excessively so. Brockman and Griffin have carried out the electrolysis in neutral solution which means that in the course of electrolysis the vicinity of the anode would have become distinctly acid, so that the coupling reaction would be slowed down. The result would be a drop in the current efficiency, and the yield of dye would be far less than that claimed by Brockman and Griffin.

It was therefore decided to reinvestigate the problem with special attention to the role of nitrite ion discharge in the reaction. This investigation, apart from testing the validity of the claims of the earlier authors, has the additional advantage of introducing a very convenient method of producing azo-dyes, which it would be worthwhile to place on a practical basis. No special precautions need be taken such as are observed with the current methods of preparing these dyes involving cooling baths and so on. The formation of the dye Roccelin was taken up for study first.

EXPERIMENTAL

I. BROCKMAN AND GRIFFIN'S METHOD

In order to verify the results claimed by Brockman and Griffin (*loc. cit.*) several runs were carried out reproducing the conditions described by these authors except that the dimensions and quantities were exactly halved. The cell consisted of a 400 c.c. Pyrex beaker inside which a polished platinum foil anode of effective area surface of 20 sq. cm. fitted snugly. A nickel rod formed the cathode and it was positioned inside a dense type alundum cup which contained the catholyte. A motor driven glass stirrer served to agitate the anolyte.

A typical run was as follows:

3·06 gm. Sodium naphthionate,
1·80 gm. $\beta$-Naphthol,
and 0·87 gm. Sodium nitrite

were taken in 150 c.c. of water in the anode compartment. The catholyte was a 5% solution of sodium hydroxide. A current of 0·5 amp. corresponding to a current density of 2·5 amps./dm.$^2$ was passed for 40 minutes, with vigorous stirring, since the theoretical requirement of current was 20 ampere-minutes. The temperature of the anolyte was 30° C. The anolyte developed a deep red colour during the electrolysis. The dye is soluble in water and was recovered from the anolyte by salting out carefully. Sodium chloride was added in small portions with good stirring till a drop of the liquid placed on filter-paper had a colourless rim. The precipitated dye was filtered at the pump, washed with dilute sodium chloride solution, dried in the air-oven at 80° C. for two hours and then in a vacuum desiccator overnight. It was then weighed. The yield of dye, which had a dark red colour, amounted to 1·15 gm. or 23% of the theoretical. This is a far lower yield than that claimed by Brockman and Griffin under the same conditions (80%).

This difference is too large to be due to experimental error. Every precaution was taken to reproduce exactly the conditions described by these authors except that the dimensions of the cell and the quantity of the components were halved. The discrepancy continued to be puzzling until it was discovered that the sodium naphthionate and $\beta$-naphthol left unreacted at the end of the run were also salted out along with the dye, if too much salt was added to the anolyte for the purpose of salting out. Naturally the product then weighed 4·6 gm. and was indistinguishable from the dye itself in colour and appearance.

II. THE INFLUENCE OF ANIONS

The results obtained above during the preliminary study clearly indicate the importance of nitrite ion discharge in the formation of the dye. Factors that interfere with the formation of free or discharged nitrite ions will therefore most likely affect the dye yields. One way of testing the validity of this conjecture would be by adding anions of different mobilities and observing if there is a corresponding change in the yield. Several runs were therefore made as already described, 1/40 Mol each of sodium chloride, sodium nitrate, sodium sulphate or sodium hydroxide being included as the addition agent. The dye yields showed a distinct dependence on the mobility of the added anion, as can be seen from the results recorded in Table I.

TABLE I

*Effect of added anion on the yield of dye*

Temperature: 30° C. Current Density: 2·5 amps./dm.$^2$

| Anion added | Ionic Mobility | Yield of Roccelin |
|---|---|---|
| $OH'$ .. | 192 | nil |
| .. | .. | 23·0% |
| $\frac{1}{2}SO_4''$ .. | 79·0 | 14·8% |
| $Cl'$ .. | 75·5 | 16·2% |
| $NO_3'$ .. | 70·6 | 22·6% |

It will be noticed that when hydroxyl ion is the added anion, the yield of dye is zero. The anolyte, during this run, developed a faint red colour only after the current had been passed for a time much longer than that theoretically required. This is probably because the highly mobile hydroxyl ion gets discharged preferentially, nitrite ions coming into the picture only at a later stage.

Dept. of Chemistry, M. V. SITARAMAN.
Presidency College, V. V. RAMAN.
Madras,
*April* 21, 1948.

1. Löb, *Z. Elektrochem.*, 1904, **10**, 237. 2. Brockman and Griffin, *Trans. Amer. Electrochem. Soc.*, 1939, **75**, 216. 3. S. Glasstone, *Industrial Chemist*, 1931, **7**, 315. 4. Conant and Peterson, *J. Amer. Chem. Soc.*, 1930, **52**, 1220.

## AN EXPLANATION OF THE INHIBITIVE INFLUENCE OF THE APPLIED POTENTIAL ON *JOSHI-EFFECT* AND ITS ENHANCEMENT IN H.F. COMPONENT OF THE DISCHARGE CURRENT

STUDIES of the *Joshi-Effect* $\Delta i$ [1,2,3], an (almost) instantaneous and reversible photo-diminution of the conductivity $i$ due to a given applied potential kV, in various gases and vapours excited in a Siemens' type (glass) ozoniser, have revealed that, in general, the magnitude of $\%\Delta i = 100\Delta i/i_{dark}$ is maximum near 'threshold potential' $V_m$, at which the system breaks down as a dielectric and $\Delta i$ occurs; and thereafter it decreases progressively as kV is increased.[3,4,5,6] Furthermore, the H. F. component ($i_{HF}$) of $i$ which is a vectorial sum of various

frequency currents,[5,7,8,9] is the chief seat of $\Delta i$.[6,8,10] In the present note an attempt is made to explain these general findings.

A Siemens' ozoniser is a system of three serial capacities: $C_1$ and $C_2$ are associated with the outer and inner tubes of the ozoniser and $C_g$ represents the capacity of the annular space filled with the excited gas or vapour. At and above $V_m$, the capacity $C_g$ may be treated as a combination of a capacity $C_g$ shunted with an ohmic resistance $R_g$ which represents the inverse of the conduction current produced in the gas due to ionisation by collision under the applied field.[11]

The electrical circuit which is generally adopted to study the *Joshi-Effect*, is shown in Fig. 1 (*a*). Fig. 1 (*b*) shows the ozoniser circuit. Let C be the resultant capacity of $C_1$, $C_2$ and $C_g$; and $R_s$ and $C_s$ [Fig. 1 (C)] in series

FIG. 1 (a)

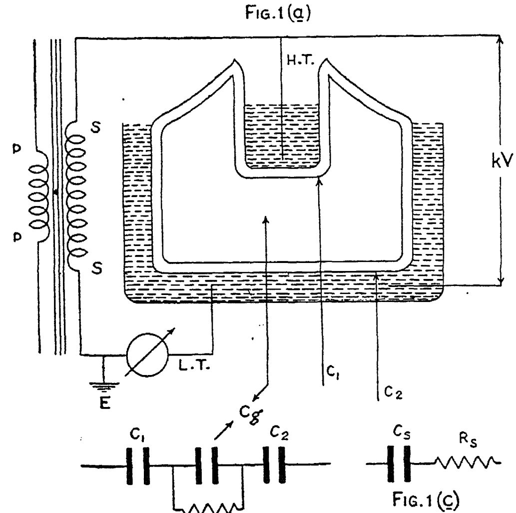



FIG. 1 (b) FIG. 1 (c)

be equivalent to $R_g$ and C in parallel. By equality of *impedances*,

$$\sqrt{R_s^2+1/\omega^2C_s^2} = 1/\sqrt{\frac{1}{R_g^2}+\omega^2C^2} = R_g/\sqrt{1+\omega C^2R_g^2} \quad \cdots \quad (1)$$

By equality of *phase angles*,

$$1/\omega C_sR_s = \omega CR_g \quad \cdots \quad (2)$$

$$\therefore R_g/\sqrt{1+\omega^2C^2R_g^2} = \sqrt{R_s^2+1/\omega^2C_s^2}$$

$$= R_s\sqrt{1+1/\omega^2C_s^2R_s^2} = R_s\sqrt{1+\omega^2C^2R_g^2}$$

$$\therefore R_s = R_g/(1+\omega^2C^2R_g^2) \quad (3)$$

and also, from (2), $C_s = 1/\omega^2 CR_gR_s$ substituting the value of $R_s$ in terms of $R_g$ and C,

$$C_s = (1+\omega^2C^2R_g^2)/\omega^2CR_g^2 = C\ (1+1/\omega^2C^2R_g^2) \ldots (4)$$

From (3), $R_s = 1/(1/R_g + \omega^2C^2R_g) = 1/(1/R_g + 4\pi^2f^2C^2R_g)$

The ohmic resistance $R_g$ is sufficiently large. Thus to a good approximation,

$$R_s = 1/4\pi^2 f^2C^2R_g \quad \cdots \quad (5)$$

and $C_s$ is very nearly equal to C.

As the applied kV is increased above $V_m$, ionisation by collision increases; and therefore, $R_g$ and C (because $C_g$ decreases) decrease. It is therefore, evident from (5) that at a constant frequency *f*, the series resistance $R_s$ increases progressively on increasing the applied kV. Since an increase in the circuit resistance is accompanied with a corresponding marked decrease in $\%\Delta i$[5,12], it is easily shown that at large kV, $\%\Delta i$ would be low. This is in good accord with numerous results[3,4,5,6] established in these Laboratories.

Oscillographic studies of the phenomenon have shown that as soon as light falls on the discharge tube, the amplitudes of various components of *i*, are suppressed to different degrees.[7,8,12] Furthermore, the larger the suppression the greater is $\%\Delta i$. It is a well known fact that the ohmic resistance damps electrical oscillations. Furthermore, the greater the value of the resistance, the larger is this damping. At a given kV, $R_g$ is (fairly) constant. Since $R_s \alpha 1/f^2$ [*vide*, equation (5)] it would be low for H.F. component as compared to its value for other components, *viz.*, $i_{LF}$ and $i_S$ the supply component and its harmonics. Thus it is seen that prior to irradiation the damping is less in $i_{HF}$ than in $i_{LF}$ and $i_S$. On the assumption that larger the amplitude of the current greater is suppression due to light, it is anticipated that $\%\Delta i$ should be in the order $i_{HF} > i_{LF} > i_S$. This is fully in conformity with results observed in various systems.[6,8,10,13]

Chemistry Department,
Benares Hindu University, B. N. PRASAD.
*June* 6, 1948.

1. Joshi and Narasimhan, *Curr. Sci.*, 1939, **9**, 535. 2. — and Deshmukh, *Nature*, 1944, **147**, 806. 3. —, Pressi. Address, *Chem. Soc.*, *Indian Sci. Cong.*, 1943. 4. —, *Proc. Indian Acad. Sci.*, 1945, **A 22**, 389. 5. Prasad, B. N., *Indian Journ. Phys.*, 1946, **20**, 187. 6. — and Jain, *Proc. Indian Acad. Sci.*, 1947. **25**, 515. 7. Joshi, *B.H.U. Journ.*, 1943, **8**, 99. 8. —, *Nature*, 1944, **154**, 147. 9. —, *Curr. Sci.*, 1946, **15**, 281. 10. —, *ibid.*, 1945, **14**, 67. 11. —, *ibid.*, 1947, **16**, 19. 12. —, *Proc. Indian Acad. Sci.*, 1945, **A 22**, 225. 13. Mohanty, *Proc. Indian Sci. Cong.*, 1947, Part III, *Phys. Sec.*, Abs. 14.

## A NOTE ON THE PROPERTIES OF PLASTER OF PARIS PREPARED FROM SEA-WATER GYPSUM

SEA-WATER contains 3·7% of total solids of which 1·36% is $CaSO_4$. The range of maximum insolubility in brine is between 15° Be and 25° Be and in consequence gypsum separates in the secondary condensers as a thin crust on the clay bed of the condensers on salterns. The deposit is usually in the form of lenticular, fibrous crystals of not more than 1/4 inch mesh closely packed together in a solid gypsum cement. The crude gypsum is obtained by washing off the adhering clay with the sea-water.

The plasters prepared from this crude gypsum under different conditions are compared with the mineral gypsum plasters. Further experiments are in progress with a view to improve the quality of the product and to examine the possibility of commercial exploitation. The

crude gypsum was freed or nearly freed from the chloride by levigation and the centrifuged product was converted to the plaster by roasting in open kettle and the compression strengths of the different samples carried out in duplicate compared. The plaster was sifted through 90 mesh and ratio of plaster to water was 100 : 60. In all cases the strengths were measured with material sifted through 90 mesh after obtaining constant weight, which usually took seven days.

TABLE I

| | Compression str. lbs./sq." |
|---|---|
| (1) Gypsum, washed and roasted: | |
| (a) fraction over 20 mesh crushed and sifted | 2010 |
| (b) fraction below 20 mesh crushed and sifted | 1250 |
| (c) crushed and sifted | 1500 |
| (2) Gypsum, crushed and washed | |
| (a) fraction over 20 mesh roasted and crushed | 1850 |
| (b) below 20 mesh roasted and crushed | 930 |
| (c) roasted and crushed | 1310 |

TABLE II

*Comparison of English Plaster (Burrells) with Local Plaster.*

| | Days | Comp. Str. lbs./sq." | Days | Comp. str. lbs./sq." |
|---|---|---|---|---|
| Burrell .. | 7 | 1575 | 14 | 1680 |
| Local .. | 7 | 1275 | 14 | 1600 |

TABLE III

*Rate of deterioration in loosely covered tins in wet weather*

| | Days | Setting time | Comp. str. lbs./sq." |
|---|---|---|---|
| Burrell .. | 14 | 3–4 minutes | 1725 |
| Local 1(a) .. | 27 | 4 minutes | 975 |
| 1(b) .. | 14 | 5–6 minutes | 880 |
| Average with other samples | | | 800–900 |

The analysis of a sample gave the following results:--

| | Present % | Theory % |
|---|---|---|
| Water .. | 6·58 | 6·21 |
| $(SO_4)$ as $CaSO_4$ .. | 88·90 | 93·80 |

The specific gravity of the sea-water gypsum and plaster were found to be 2·25 and 2·62 respectively as compared with figures for mineral product being 2·30—2·33 and 2·57 respectively. Taking Eckel's figures of analysis of mineral plaster it is seen that the purities of the two compare favourably as indicated below:

| | $+Al_2O_3$ $+MgCO_3$ $SiO_2+Fe_2O_3+CaCO_3$ | $CaSO_4$ | $H_2O$ |
|---|---|---|---|
| Mineral plaster | 4·26% | 89·42% | 6·8% |
| Sea-water plaster | 4·50% | 88·90% | 6·6% |

CONCLUSION

The foregoing results indicate the possibility of getting a good quality plaster from the sea-water gypsum obtained as a by-product at little cost during salt manufacture. It is seen that the plaster from this source compares favourably in many respects to the mineral plaster, though the lower maximum strength, slower rate of hardening and higher rate of deterioration under humid condition militate against its use in dental work. The ultimate strength seems to depend on the original size of particles of gypsum and not on chemical composition. The results in Table I show that the strength depends to a large extent on particle size and that the sequence in the operations add to the effect as a result of variations in the impurities present. Further experiments are in progress with a view to throw greater light into the variations in properties of different plasters and to find out if the sea water gypsum plaster cannot be made to approach the mineral plaster in its properties by economical methods.

Salt Department,
Ceylon, N. G. BAPTIST.
*June* 10, 1948.

1. Eckel, *Cements, Limes and Plasters*, II Edition, 1922.
2. Edwards, *Amer. Inst. of Chem. Engineers Trans.*, 1924, **16**, 39.

## ANÆMIA IN CHICKS INFECTED WITH *P. GALLINACEUM*

THE significance of anæmia in malaria has been emphasised by many investigators.[1,2,3,4] In the ducks infected with *P. lophuræ*, the degree of anæmia is proportional to the number of parasites in the peripheral blood. A marked drop in the total number of r.b.c. occurs as the peak of parasitæmia is approached; the level of hæmoglobin and the total red cell count returning to normal in the course of 3-5 days after the peak of infection. Death usually occurs on the 10-12 day if not treated. Hill[5] has concluded from her studies on pigeons infected with *P. relictum* that death results from anæmia. Hewitt[4,6] has shown in his study of the morphology of r.b.c. of malaria-infected ducks that varying degree of polychromasia occurs. The nuclei are larger than those of the mature cells and these cells may be round or elliptical. Binucleated and anucleated forms and deeply basophilic erythroblasts may also be found in severe infections. Owing to the similarity of the course of malaria infection in chicks, the present investigation was undertaken with a view to study the hæmatology of chicks infected with *P. gallinaceum*.

Chicks, 8-12 weeks old, were used for the purpose. The strain of the malaria parasite was originally obtained from the King's Institute, Guindy, and was passed by blood inoculation through chicks of different ages and breed, before being transferred to the present series under experiment.

Intramuscular inoculations have been used exclusively throughout the present work. Donor blood was drawn by venipuncture through a hypodermic needle and citrated saline (2·0 per cent. sodium citrate, 0·9 per cent. saline) in amounts equal to the quantity of blood drawn has been used as diluent.

Blood smears were stained with Geimsa and Leishmann stain and parasite counts have been expressed for 500 red cells. This represents the actual number of red cells counted on each slide. Hæmoglobin determinations were made by Sahli's hæmoglobinometer. The total r.b.c. count was done by the usual standard method. Smears were also taken of the bone marrow from the femur, and of the liver, spleen from the infected as well as control birds.

It was observed that the degree of parasitæmia and the severity of anæmia varied with the age of the bird and the size of the inoculum. The course of a typical infection which ended in death is shown in Fig. 1. The

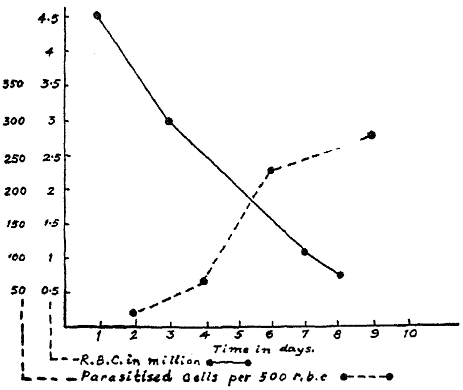



FIG. 1

degree of anæmia is found to be proportional to the parasitæmia. In the case of chicks the peak of parasitæmia was reached on the sixth or seventh day and then the number of parasites in peripheral blood rapidly decreased until only a few were present on the ninth day. In those that survived, the hæmoglobin and red cell count steadily increased from the tenth day onwards. The level of hæmoglobin and colour index run parallel with the total number of erythrocytes in the peripheral blood (Fig. 2).

All the infected birds showed a marked increase in the percentage of young red cells of erythroblastic type. Near the time of death immature forms of erythrocytes enter the peripheral circulation. There was a marked hæmopoetic response of the bone marrow, liver and spleen but the greatest proliferation was found in the bone marrow. With the progress of the anæmia there was an increase in the number of erythroblasts in the peripheral

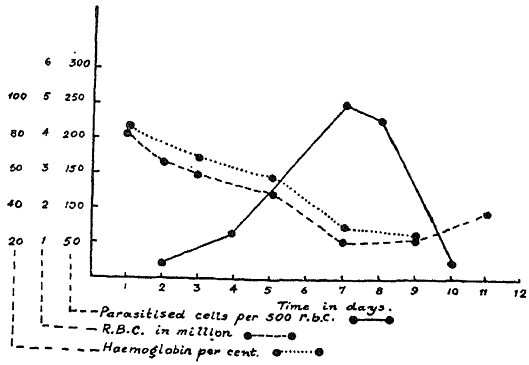



FIG. 2

blood, but variations in the size and shape were noticed during the course of infection. These immature red cells were at first elliptical in shape and slightly smaller than the adult erythrocytes, but as the anæmia progressed and great strain was placed on the bone marrow, the peripheral circulation was flooded with even younger cells; many of these being very small and almost spherical in shape.

The results of our observation were similar to those reported by Hewitt[4], and Rigdon and Rostorfor.[7] It is interesting to note that the young types of erythroblasts in the peripheral blood did not have any parasites in their cytoplasm. The reduction in the number of parasites in the peripheral blood following the peak of parasitæmia might be directly related to the characteristics of this type of anæmia; the parasites apparently prefer the young erythrocytes, to the young erythroblasts.

Our thanks are due to Dr. K. P. Menon for his keen interest and kind encouragement during the course of this work.

Pharmacology Laboratory,
Indian Institute of Science,
Bangalore, N. N. DE.
*June* 28, 1948. A. S. RAMASWAMY.

1. Young, M., *Am. J. Hyg.*, 1937, **26**, 322-36. 2. Terzian, L., *Ibid.*, 1941, **33**, (Sect C): 1–22, 33–53. 3. Talliaferro, W., and Kluver, C., *J. Inf. Dis.*, 1940, **66**, 153–65. 4. Hewitt, R. I., *Am J. Hyg.*, 1942, **36**, 6–40. 5. Hill, Claire Mc Dowell, *Ibid.*, 1 42, **36**, 143. 6. Hewitt. R. I, Richardson, A. R., and Seager, L. D., *Ibid.*, 1942, **36**, 362–73. 7. Rigdon, R. H., and Rostorfor. H. H., *Blood*, 1947, **2**, 244–55.

## STUDIES IN ANTIMALARIALS: SOME R- AND R'- DISUBSTITUTED GUANIDINES

THE discovery, that *p*-tolyl-guanidine nitrate has a very slight retarding action on a sporozoite-induced infection of *P. gallinaceum* in chicks[1], prompted investigations on the synthesis of a large number of mono- and disubstituted guanidines with a view to studying

TABLE I

| No. | Substituted guanidines RNH–C(: NH)–NHR′ | | Salt | m.p. ° C. |
|---|---|---|---|---|
| | R | R′ | | |
| 1[4] | p-Cl–$C_6H_4$–, | H | $HNO_3$ | 141–42 |
| 2 | p-Cl–$C_6H_4$–, | -$CH(CH_3)_2$ | $CH_3COOH$ | 175–76 |
| 3 | p-Cl–$C_6H_4$–, | p-Cl–$C_6H_4$–, | HCl | 172 |
| 4 | p-Cl–$C_6H_4$–, | p-$CH_3O$–$C_6H_4$–, | $CH_3COOH$ | 156–57 |
| 5 | p-Cl–$C_5H_4$–, | 2′-4′$(CH_3)_2C_6H_3$–. | $CH_3COOH$ | 155 |
| 6 | 8-Cl–5–$C_9H_5N$–, | p-Cl–$C_6H_4$–, | $CH_3COOH$ | 175–76 |
| 7 | 8-Cl–5–$C_9H_5N$–, | -$CH(CH_3)_2$ | $CH_3COOH$ | 180 |
| 8 | p-$CH_3$–$C_6H_4$–, | -$CH(CH_3)_2$ | $CH_3COOH$ | 181–82 |
| 9 | p-$CH_3O$–$C_6H_4$–, | -$CH(CH_3)_2$ | HI | 125 |
| 10 | p-$NO_2$–$C_6H_4$–, | -$CH(CH_3)_2$ | $CH_3COOH$ | 159–60 |
| 11 | 2 : 4-$Cl_2$–$C_6H_3$–, | -$CH(CH_3)_2$ | $CH_3COOH$ | 156–57 |

their activity on malarial infection. King and Tonkin[1] found that out of the compounds they had prepared, *p*-anisyl-guanidine nitrate had the maximum activity. Andrews *et al.*[2,3] postulated that such types of compounds, which were of comparatively small molecular structure, might be capable of penetrating the blood-cells of a sporozoite-induced infection of *P. gallinaceum* in chicks, and have their effect upon the tissue-phase development before the blood became infected.

A number of aromatic and aliphatic substituted guanidines [Table I] have now been synthesized to study the effects of different nuclei, with different substituents therein, on malarial infections.

The compounds were prepared by condensing the amine hydrochloride with the appropriate cyanamides in alcoholic solutions, by refluxing for 6-10 hours. After the reaction was over, the base was liberated from the reaction mixture, by treating it with dilute alkali solution, and was purified by crystallising from organic solvents. The compounds were characterised as acetates or hydrochlorides.

Various unsuccessful attempts were made to condense 2-chloro-7-methoxy-9-amino-acridine hydrochloride and 6-methoxy-2-amino-benzothiazole hydrochloride with isopropyl-cyanamide.

Full details will be published elsewhere.

Thanks are due to Dr. B. H. Iyer for his kind interest in the work, and to the Lady Tata Memorial Trust for the award of a research scholarship to one of us (P. R. Gupta).

Organic Chemistry Laboratories, P. R. GUPTA.
Indian Institute of Science, P. C. GUHA.
Bangalore,
*July* 15, 1948.

1. King, H., and Tonkin, I. M., *J. C. S.*, 1946, 1063. 2. Andrews, King, Vanden Ende and Walker, *Lancet*, 1944, 777. 3. Andrews, King and Walker., *Proc. Roy. Soc.*, 1946, B. **133**, 20. 4. Das Gupta, P. K., Gupta, P., and Basu, U. P., *Science and Culture*, 1945–46, **11**, 704.

## THE NITRATION OF 2-NITRO-ACET-PARA-TOLUIDIDE

SCOTT AND ROBINSON[1] who used potassium nitrate and concentrated sulphuric acid, obtained the 2 : 5-dinitro isomer as the chief product of the nitration of 2-nitro-acet-*p*-toluidide. They also made the observation that when nitric acid alone was employed for this purpose it was the 2 : 3-dinitro-acet-*p*-toluidide which predominated. Later, Page and Heasman[2] reported the formation of both these isomerides, using nitric acid alone, and they outlined a method of separation of these which involved deacetylation and crystallisation of the resulting bases from benzene and alcohol.

As it was necessary to prepare the pure 2 : 5-dinitro-*p*-toluidine, in quantity, for the purpose of another investigation in this laboratory, we have now repeated carefully both the procedures, and we are able to say that in so far as the preparation of the 2 : 5-dinitro-*p*-toluidine is concerned, Scott and Robinson's method is definitely superior in that the desired product could be obtained by one crystallisation in a pure condition (M.P. 189° C.) and in tolerably good yields (25% of theory). Attempts made to reproduce the results described by Page and Heasman were unsuccessful: no effective separation of the mixed bases by crystallisation from benzene and alcohol was found possible, although a very small quantity (0·3 gm.) of the 2 : 5-dinitro-base (M.P. 189°C; acetyl derivative M.P. 122° C.) could be isolated by subjecting the mixture to prolonged distillation in steam.

Page and Heasman aver that the first product of nitration by Scott and Robinson's method, crystallised from alcohol, which, according to the latter, melted at 132·5° C.—we found the product to melt over a range of 130-36° C.—could not be the pure 2 : 5-dinitro-acet-*p*-toluidide but only a mixture. This contention has been found to be correct by us. The pure 2:5-dinitro-acet-*p*-toluidide prepared by the acetylation of the corresponding toluidine melts at 122° C., which agrees with the melting point given by Page and Heasman for the product. It is very probable that Scott and Robinson did not reacetylate the liberated pure base, the

melting point of which (189° C.) has been correctly recorded by them, for in that case the discrepancy could not have escaped detection. This seems to be all the more unfortunate in view of the fact that Scott and Robinson did not claim that the 2:5-dinitro derivative was the sole product of nitration with potassium nitrate and sulphuric acid, but only the chief product.

The above mode of nitration, using potassium nitrate and sulphuric acid, has now been extended to that of *m*-chloracetanilide. In this case, 4-nitro-3-chloro acetanilide (M.P. 144°C.) was found to be the main product (yield, 54% of theory), whilst if nitric acid alone was employed, as was previously done by Hodgson and Kershaw,[3] a mixture of 4- and 6-nitro-3-chloracetanilides results, entailing a tedious process of separation.

Investigation on this line is being continued and details will be published elsewhere.

Our thanks are due to the Council of Scientific and Industrial Research, India, for a grant which defrayed the expenses of this investigation and for permission to publish the preliminary results. Our thanks are also due to Professor R. D. Desai of the Department of Chemical Technology, University of Bombay, for the kind gift of 100 gm. of *m*-chloraniline hydrochloride.

Chemical Laboratories, Presidency College, Madras,
*August* 12, 1948.

B. B. Dey.
R. Krishna Maller.
B. R. Pai.

1. Scott and Robinson, *J. Chem. Soc.*, 1922, **121**, 844. 2. Page and Heasman. *ibid.*, 1923, **123**, 3235. 3. Hodgson and Kershaw, *ibid.*, 1929, 29, 19.

## *VOLVOX* IN NORTH INDIA

To the algologist, the occurrence and distribution of the very interesting green alga, *Volvox*, always has a peculiar fascination. The distribution of this genus in India has still to be fully worked out. It has been so far recorded from a small portion of the country only *viz.*, South India and Bombay Presidency, and practically nothing is known regarding its occurrence in the rest of India; which forms the major portion of the country. Iyengar (1933), in his excellent monograph, on the Colonial Volvocales of South India, has given an account of a number of species of *Volvox* occurring in the area. And Apte (1936) has given an account of a few species of *Volvox* from Poona and its neighbourhood in the Bombay Presidency.

The writer collected a *Volvox* from Lucknow in 1929 and sent it to Professor Iyengar, who described it as a new variety, *V. Rousseletii* West var. *lucknowensis* Iyengar (Iyengar, 1933, pp. 350, 351, 370). Last year, the writer collected in October four more species of *Volvox* within the University area at Lucknow from shallow rain-water pools fully exposed to the sun. These four species occurred each separately in pools which were separated from each other by very short distances, only 30 to 40 yards. Three of these species were identified as *V. globator* (L.) Ehrenberg, *V. Carteri* Stein and *V. africanus* West, respectively, while the fourth species could not be identified owing to the absence of the necessary stages.

Of the four species which were collected by the writer in Lucknow, *V. Rousseletii* var. *lucknowensis* is known so far only from Lucknow. *V. Carteri* was first collected by Carter (1859) in Bombay and described by him under the name of *V. globator*, but was later on established as a new species, *V. Carteri*, by Stein (1878) (see Iyengar, 1933, p. 363). *V. Carteri* has since been recorded from Madras by Iyengar (1933) and from Poona by Apte (1936). And *V. globator* and *V. africanus* have been recorded from Bangalore and from Nandi Hills (Mysore Province), respectively, by Iyengar (1933).

Now the fact that four species (five species, if we include the unidentified one) have been collected within a very small area in a single place like Lucknow suggests that the genus is quite likely to be found in several other parts also of North India, if algologists should be on the look out for this genus in these different parts of the country.

The writer in conclusion wishes to express his indebtedness to Professor M. O. P. Iyengar for his kind help in preparing this note.

Department of Botany, University of Lucknow,
*May* 15, 1947.

A. R. Rao.

1. Apte, V. V., "Observations on some species of *Volvox* with the detailed description of *Volvox poonensis*", *The Journal of the University of Bombay*, 1936, **4**, Pt. 5, 1–16. 2. Carter, H. J., "On fecundation in two Volvoces, and their specific differences," *Ann. and Mag. Nat. Hist.*, 1859, 3rd Ser., **3**, 1–20. 3. Iyengar, M. O. P., "Contributions to our knowledge of the colonial Volvocales of South India," *Journ. Linn. Soc. Bot.*, 1933, **49**, 323–73. 4. Stein, F., *Der Organismus der Infusionsthiere*, 1878, **3**, 1.

## *UROMYCES ACORI* RAMAKRISHNAN AND RANGASWAMI SP. NOV., ON *ACORUS CALAMUS* L.

*Acorus calamus* L. grows well in marshy places and on the banks of lakes in Ootacamund and its neighbourhood. In March 1948 it was found to be infected by a rust. The incidence of the rust was more in shaded localities than in open areas. Both uredial and telial stages were observed. These are described below.

Uredia amphigenous, oval, isolated, sometimes gregarious, 1 mm. in length, erumpent, subepidermal, brown in colour; urediospores, pedicellate, subglobose, elliptical or obovate $24 \times 22\,\mu$ $(22-33 \times 19 \cdot 5-25 \cdot 0)$ yellowish brown to reddish brown, echinulate to verrucose, mixed with clavate, subhyaline or hyaline paraphyses.

Telia closely resemble uredia and found mixed with them on both sides of the leaf; teliospores pedicellate, one-celled, ovate to elliptical, $30 \times 21\,\mu$ $(27-36 \times 16-25)$ yellowish brown in

colour, with an apical thickening upto 14 μ and single germ pore at the apex, stalks persitent, up to 41 × 11 μ, hyaline or subhyaline; paraphyses hyaline or subhyaline, clavate, mixed with teliospores.

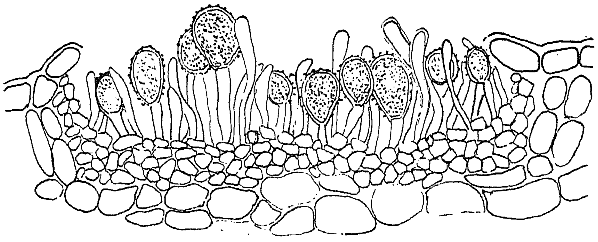


FIG. 1. Section through uredium × 335

On living leaves of *Acorus calamus* L. Ootacamund, 24th March 1948, T. S. Ramakrishnan and G. Rangaswami (type).

Soris uredosporiferis amphigenis, ovalis, isolatis, interdum aggregatis, 1 mm. longis, erumpentis, subepidermis, brunneis; uredosporis pedicellatis, subglobosis, ellipticis vel obovatis, 24 × 22 μ (22–33 × 19·5–25·0) echinulatis vel verrucosis, flavo-brunneis vel rubrei-brunneis; paraphysibus numerosis, clavatis, sub-hyalinis vel hyalinis.

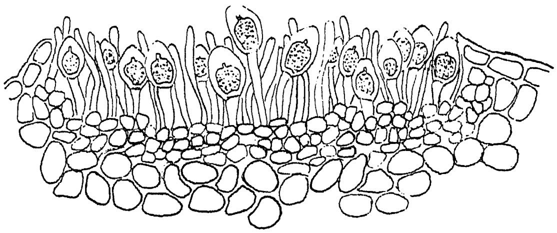


FIG. 2. Section through telium × 160

Soris teleutosporiferis conformibus, urediis immixtis, amphigenis; teleutosporis pedicellatis, unicellatis, ovatis vel ellipticis 30 × 21 μ (27–36 × 16–25), flavo-brunneis, apice incrassatis, usque 14 μ, poris germinationis 1, pedicelli persistenti, hyalini vel subhyalini, usque 41 × 11 μ, paraphysibus clavatis, subhyalinis vel hyalinis.

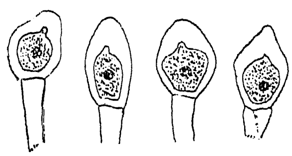


FIG. 3. Teliospores. × 335

In vivis foliis *Acori calami* L. Ootacamund, 24th March 1948, T. S. Ramakrishnan et G. Rangaswami.

Raciborski (Saccardo, 1902) has described *Uredo acori* on *Acorus terrestris* Spreng. from Java. Sydow, H. and P., and Butler (1906) have noticed the same rust on *Acorus calamus* from Gauhati, Assam; and Uppal *et al* (1934) have recorded it on the same host from Poona, Bombay. The rust under study has the uredial stage closely resembling that of *Uredo acori* Rac. already recorded, in spore shape and size though in the description of the fungus by Saccardo no mention is made of the presence of paraphyses. An authentic specimen was kindly supplied by Dr. M. K. Patel from Poona and paraphyses were noticed in this. The uredial stage of the rust under study is found to be identical with *U. acori*. The perfect stage of the fungus has now been observed. The telia and uredia are mixed together and occur on the same leaf. Therefore they are considered to belong to the same rust. The telial phase of the fungus shows it to be *Uromyces* and the rust is named as *Uromyces acori*.

Department of Mycology,
Agricultural College and Research Institute,
Coimbatore,
*June*, 23, 1948.

T. S. RAMAKRISHNAN.
G. RANGASWAMI.

1. Saccardo, P. A., *Syll. Fung.*, 1902, **16**, 357. 2. Sydow, H. and P., and Butler, E. J., *Ann. Myc.*, 1906, **4**, 443. 3. Uppal, B. N., Patel, M. K., and Kamat, M. N., *Fungi of Bombay*, *Dept. Agri. Bombay*, *Bull.*, **176**, **1934**, 16.

## PISTILLODY IN SACCHARUM

FROM among the graminaceous plants occurrence of pistillody has been recorded by Anthony[1] and Leighty and Sando[4] in wheat. Isolated instances of pistillody were noticed at this Station by Dutt and Krishnaswami[2] in a few spikelets of the varieties Taboe Woelong and Shamsara as also in a seedling of Glagah × Co. 331, but in the instance recorded below pistillody seems to be a feature or a characteristic of this particular seedling and occurs in all the inflorescences and in all spikelets. The pistil parent of this seedling is *S. spontaneum*, L. (Uganda) which in itself is peculiar among *spontaneums* in that according to Dutt and Krishnaswami[2] it is protogynous.

During the flowering season of 1945-46, an instance of abnormality involving partial or complete transformation of the stamens into processes bearing stigmatic hairs was noticed in a hybrid seedling G. 5023. The malformation was noticed in all the arrows and in each and every spikelet and in all cases all the three stamens were affected, though variation was met with in the degree of transformation of the stamens.

In the upper portion of the arrow, there was complete transformation of the stamens into carpels. The extreme case was wherein all the three stamens were transformed into carpels. In structure these had a membranous ovary-like sac at the bottom with one or two stylar branches having feathery stigmatic hairs (Fig. 3). These bore no resemblance to stamens and could be judged to be transformed stamens only from their positions. In other cases, half of the anther was transformed into carpel while the other half retained its shape, though the contents in the sac were only a pulpy mass. In the transformed portion there

were one or two stylar branches with stigmatic hairs (Fig. 4). In this case a membranous structure slightly swollen and resembling an ovary was noticed in the bottom portion.

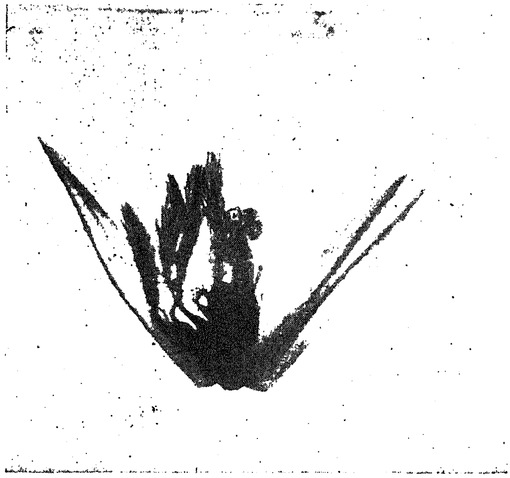


FIG. 1. Shows a spikelet with the glumes opened out and the essential organs *in situ*.

In the lower portion of the arrow, the anthers were normal in size but invariably had feathery stigmatic branches on top (Fig. 5). In others though the dehiscence was normal, the little pollen which was available was unhealthy and did not germinate *in vitro* or *in vivo*. In the middle portion of the arrow all the different degrees of transformation were met with in the same spikelet. This is illustrated in Fig. 2, while Fig. 1 shows the essential organs of the spikelet with the glumes opened out.

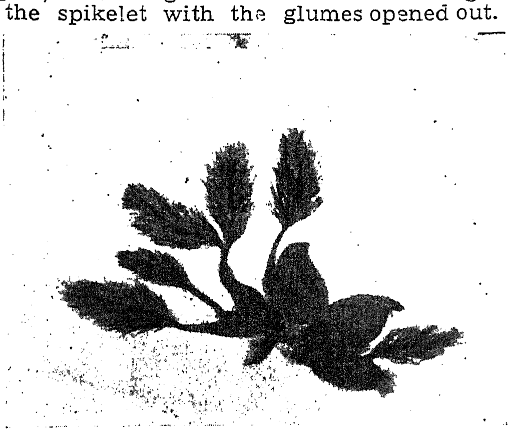


FIG. 2. Shows the different degrees of transformation of the anthers in the same spikelet.

When the arrow was selfed, there was no seed setting indicating that the little pollen available was not capable of fertilising the ovule. Normal seed setting was observed when foreign pollen was used, but it was always the normal carpel which produced the seed.

The above pistillody in G. 5023 was noticed during all the three flowering seasons from 1945-47. This would appear to be due to inherent genic factors and not to influence of environmental conditions.

Another interesting feature noticed in G. 5023 was that like its pistil parent, *S. spontaneum*, L. (Uganda), it is also protogynous. Even the few anthers that dehisce open only two days after the coming out of the stigmas. This coupled with the phenomenon of pistillody enables the variety being used as an ovule parent.

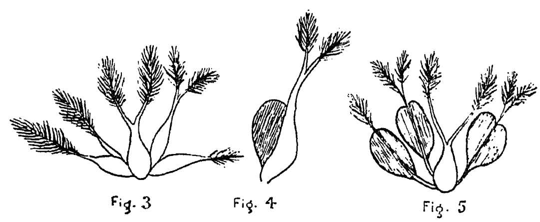



FIG. 3. Shows all the three stamens transformed into carpels. FIG. 4. Shows half the anther transformed. FIG. 5. Shows three normal anthers but with stigmatic branches on top.

A seedling of *S. spontaneum*, L. (Uganda) and *Sorghum rigidifolium* also showed such abnormalities though not to such an extent. Herein the anthers have been partially transformed, there being one or two stylar branches on top of the generally shrivelled anthers which are a pulpy mass containing no pollen grains.

Sugarcane Breed. Station, Coimbatore,
N. L. DUTT.
J. THULJARAM RAO.

*June* 29, 1948.

1. Anthony, S., *Jour. Heredity*, 1918, 19. 2. Dutt, N. L., and Krishnaswami, M. K., *Proc. Assoc. Econ. Biol.*, 1939. 3. —, —, *Curr. Sci.*, 1943, **12**, 1. 24 4. Leighty, C. E., and Sando. W., *Jour. Heredity*, 1924, 16

## CHROMOSOME NUMBER AND EFFECT OF COLCHICINE ON CHROMOSOMES OF *COLCHICUM LUTEUM*, BAKER

*Colchicum luteum*, Baker is a Lileaceous plant growing in Afghanistan, Turkistan and Western Himalayas—extending from Murree Hills to Chamba and Kashmir at an altitude of 4,000 feet to 7,000 feet on grasslands. It is an Indian substitute for the European *Colchicum autumnale* as the source of drug Colchicine.

The material was collected from Murree Hills. The corms were grown in December 1946 in pots containing sand which was irrigated regularly with Knops solution. The pots were kept in green-house. Corms produced roots abundantly in about two weeks time.

The root tips fixed were in Craf's fixative. Observations were made from paraffin sections 10 to 12 $\mu$ thick which were stained with Crystal Violet-Iodine.

The chromosome number is 38 (Fig.). The chromosomes usually occur in small groups.

Somatic metaphase from a root tip cell showing $2n=38$ × 3,000

Thus it was difficult to count the chromosome number easily. There were obtained, however, some good plates in which the chromosomes could be easily counted.

Some of the chromosomes are dot-shaped and some are comparatively longer. The position of the kinetochore in the long chromosomes appears to be median or nearly so. Two of the chromosomes in the karyotype possess a satellite each with a fine stalk.

The chromosome numbers of other 10 species of the genus as observed by Levan (1940*b*) form an anueploid series of 36,38,40,42,44 and 54. This diversity in the chromosome number coupled with the fact that even in the same species the number varies (Levan, 1940*b*) is interesting. Until detailed studies of mitosis and more particularly meiosis are carried out, it is difficult to throw any light on the basic chromosome number and the nature of polyploidy in the genus.

Incidentally the effect of Colchicine was tried on the root mitoses. The corms with good number of roots were placed in the Colchicine solutions ranging from ·4%–2% for one day to 62 days. During all this time there was no sign of the macroscopic c-tumours so characteristic of the roots treated with Colchicine. The root growth was not at all accelerated or impaired in any way. It was perfectly normal. Longitudinal sections of the treated material fixed at regular intervals, showed that mitoses occur quite normally even when roots were placed in an overdose (2%) of Colchicine for over two months. This observation is in close accord with those of Blakeslee (1939) and Levan (1940*a*) on *Colchicum autumnale*.

This clearly shows that besides *Colchicum autumnale* the spindle of *Colchicum luteum* is also not at all susceptible to Colchicine. Experiments may show that this may be true for all the species of the genus. The genus *Colchicum* seems to have developed this immunity towards Colchicine owing to its faculty of producing the drug in its tissues.

Botany Department, P. N. Mehra.
E. P. University, Amritsar. T. N. Khoshoo.
*July* 18, 1948.

1. Blakeslee, A. F., "The present and potential service of chemistry to plant breeding," *Amer. Jour. Bot.*, 1939, **26**, 163. 2. Levan, A., "The effect of Acenaphthene and Colchicine on Mitosis of Allium and Colchicum," *Hereditas*, 1940*a*, **26**, 262. 3. Levan, A., "Note on Somatic Chromosomes of Some Colchicum species," *Ibid.*, 1940*b*, **26**, 317.

## *XANTHOMONAS MALVACEARUM* (ERW. F. SMITH) DOWSON ON EXOTIC COTTONS IN INDIA

Several workers in India have mentioned from time to time the occurrence of bacterial leaf-spot of cotton, although none has so far isolated the pathogen in a pure state. In fact, confusion has existed between this disease, *Alternaria* leaf-spot and anthracnose of cotton.

This disease, also known as angular leaf-spot or black-arm, is quite common on exotic cottons grown at Broach, Dharwar, Gadag, Jalgaon, Surat and Viramgam. Outside this Province, it has been reported from Bellary, Coimbatore and Salem in the Madras Province, Parbhani in Hyderabad State and in the Punjab. The pathogen has now been isolated in pure state for the first time from diseased leaves of exotic cottons received from several places in Bombay Province.

The disease closely resembles the one described by E. F. Smith (1901),[1] which is characterised by minute water-soaked spots measuring 1 to 2 mm. on the lower side of young leaves. These spots look translucent when held against light. During monsoon, the disease can be reproduced in the glasshouses at Poona, 4 days after inoculation. In addition to the lamina of the leaf, the mid-vein, lateral veins and the edges are also infected. The water-soaked spots become brown with purplish margins and ultimately turn black. Gummy bacterial exudations are often found in the form of a crust or scales on the under-surface of the leaves. In severe cases of infection, when several lesions coalesce and veins are attacked, the leaf looks typically wrinkled. Such leaves turn yellow and fall to the ground.

On punctured stems and petioles, the pathogen produces elongated, grayish to sooty black areas after an incubation period of 7 days. Heavily attacked stems show deep cracking and gummosis and can easily be broken by wind, while the infected petioles droop. This stage of the disease is known as 'black-arm'.

Infection of bracts is more visible in the case of 'Sakel' cotton (*G. barbadense*). Young succulent bolls, 13 days after inoculation, show round, raised spots, which become irregular in shape, brown in colour and depressed in the centre. Bacterial ooze in the form of small shining beads is found in the centre of depressed spots, which later turn deep black. Badly affected bolls remain small and shrunken and

drop down prematurely. Mature bolls, when attacked, do not open properly, while lint from such bolls is usually stained yellow. The description of *X. malvacearum* (Erw. F. Smith) Dowson as determined by us is given below:—

Short rods with rounded ends, single or in pairs, rarely in chains, motile by a polar flagellum, gram-negative, not acid fast, capsulated, no spores, strict aerobe.

On potato dextrose agar, the colonies are round, smooth, glistening, butyrous, baryta yellow (Ridgway), convex, no distinctive odour, striations starting from midway coming upto the periphery, 2 cm. in diameter in 7 days. Starch attacked; hydrogen sulphide produced; litmus reduced; nitrates not reduced; produces acid but no gas from dextrose and galactose, but not from mannitol, lactose, raffinose and xylose. It makes no growth in Cohn's and Uschinsky's solutions; M.R.V.P. tests negative; Loeffler's blood serum not liquefied in 10 days; indol and ammonia not produced; optimum pH for growth 6·9 to 7·1; optimum temperature for growth 31-32° C. ; sodium chloride tolerant upto 2 per cent.; the thermal death point approximately 50° C.

Exotic cottons belonging to *Gossypium barbadense, G. purpurascens, G. hirsutum,* and *G. thurberi* groups are susceptible in the descending order while some Indian cottons belonging to *G. herbaceum* and *G. arboreum* groups are highly resistant. The organism failed to infect other Malvaceous plants. Further studies on the longevity of the pathogen in the soil and on the seeds, detailed physiology, reactions of Indian cottons, interspecific hybrids and possible methods of control are in progress.

The authors are extremely thankful to Dr. B. N. Uppal, Director of Agriculture, B. P., Poona, for helpful suggestions made during the course of this investigation.

Plant Pathological Laboratory, M. K. PATEL.
College of Agriculture, Poona, Y. S. KULKARNI.
*July* 2, 1948.

1. Smith, E. F., *Introduction to Bacterial Diseases*, 1920 (W. B. Saunders Co., Philadelphia).

## YELLOW MOSAIC OF LETTUCE

LETTUCE plants (*Lactuca sativa* Linn.) grown in the mycological area of this Institute during 1946-47, were found to be affected by yellow mosaic disease. In 1947-48, the disease appeared in a severe form and the percentage of infection varied from 50-80. The first visible symptom in the field is clearing of veins of the youngest leaves associated with pale yellow mosaic mottling. Later, the mosaic symptoms become more pronounced and the lamina gets distorted (Fig. 1). The old infected leaves are much thickened and leathery and have chlorotic areas along the margins. The inflorescence axes borne by diseased plants are not distorted but flowers are few in number. In severely infected plant leaves are not attractive enough to be used for table purpose and the disease thereby reduces their market value.

FIG. 1. Diseased leaves of lettuce affected by yellow mosaic virus.

Under glasshouse conditions in 6-8 days artificially inoculated lettuce plants develop small pale yellowish areas on the youngest leaves along with clearing of the veins. Distortion of the lamina and curvature of the midrib are commonly met with in older leaves. With age mosaic mottle becomes more pronounced and yellow areas on the upper surface of the lamina may be raised with a corresponding depression on the under-surface.

*Transmission.*–The virus is sap-transmissible. In 1946-47 about 5 per cent. of the plants raised under controlled conditions from seed obtained from the local market were found to be affected by yellow mosaic virus while in 1947-48, the percentage of infection in plants raised from seed of infected plants during the previous season was as high as 30.

*Properties of the virus.*—The properties of the virus were studied by inoculating young lettuce plants raised under insect-proof conditions with standard extract of the infected plants which had been subjected to different treatments.

The virus remains infective after an exposure for 10 minutes to 86° C., but it loses infectivity when exposed to 87° C. for the same period. The virus retains its infectivity after 60 days storage at room temperature (15°-25° C.) but is rendered innocuous after storage for 64 days. Crude juice of the infected plants when diluted to 1 : 60,000, was found to be infective whereas at 1 : 70,000, it becomes innocuous.

*Host range.*—The disease is transmissible besides lettuce to. *Nicotiana tabacum* varieties Harrison's special and *White Burley* and *Lycopersicum esculentum* var. Sutton's early market. Mottling and vein-thickening are the prominent symptoms in *N. tabacum* variety Harrison's special while in var. *White Burley* small elliptical pale yellow patches develop which become more pronounced in 25-30 days. Yellow mosaic mottle and thickening of the veins are the chief symptoms in tomato. Blistering, which is commonly seen in severely affected lettuce plants, is not met with in tobacco or tomato. All attempts to infect sweet pea plants with the virus were unsuccessful.

Jagger[1] reported a serious mosaic disease of lettuce from Sanford, Florida, and established its transmission through seed. It, however, differs from the virus studied at Delhi in having a thermal death-point of between 55° and 60° C., a longevity *in vitro* of 24 to 28 hours and extremely low dilution end-point.[2] Moreover, lettuce mosaic virus (*Lactuca* Virus 1)

is readily transmissible to sweet pea *Lathyrus odoratus* in which small brown lesions appear on the main stem.[3] Severin[4] and Linn[5] reported lettuce yellows disease caused by aster (*Callistephus chinensis*) yellows virus which results in yellowing, blanching and curling of the inner leaves; margins of these curled leaves develop small brown spots. Other virus diseases recorded on lettuce by Smith[2] are Dandelion yellow mosaic, cucumber yellow-mottle mosaic, tomato spotted Wilt and 'Big-vein'. Symptoms of all these appear to be different from yellow mosaic disease of lettuce now described.

Division of Mycology and Plant Pathology, Indian Aricultural Research Institute, New Delhi,
*July* 27, 1948.

R. S. Vasudeva.
S. P. Raychaudhuri.
P. S. Pathanian.

1 Jagger, I. C., *J. Agric. Res*, 1921, **20,** 737–40. 2. Smith, K. M., *Virus Diseases of Farm and Garden Crops*, Littlebury & Co., Ltd., 1947, 56–58. 3. Ainsworth, G. C., *Ann. appl. Biol.*, 1940, **27,** 218–226. 4. Severin, H. H. P., *Hilgardia*, 1929, **3,** 543–71. 5. Linn, M. B., *Bull. Cornell Univ. Agric. Expt. Sta*, 1940, **742,** 33.

## A NEW BACTERIAL DISEASE OF *IPOMOEA MURICATA*

A new bacterial disease of *Ipomœa muricata* growing on the hedges and on the banks of river near Poona had been noticed for the first time in the rainy season of 1947. The disease is characterised by minute spots with bright yellowish areas which enlarge and involve a large part of leaves which become brown and brittle. Infection sometimes follows the veins and when severe, brings about distortion and wilting. Infection occurs through stomata or through vascular system and as such it resembles bean blight or cowpea blight. The pathogene has been isolated in pure state by ordinary plating method. The organism is new to science and hence has been assigned a specific rank.

*Xanthomonas Uppalii* sp. nov.—Rods with rounded end, $2 \cdot 2 \times 0 \cdot 9\ \mu$. Motile with a single polar-flagellum. Gram-negative. Non-capsulated. Not acid fast. No spores. Mostly single. Gelatin liquefied. Fair, smooth, dull, filiform lemon-chrome growth on nutrient agar. Litmus in milk reduced. Nitrites, ammonia and indol not produced. Hydrogen sulphide produced. No growth in Uschinsky's, Cohn's and Koser's uric acid media. Acetyl-methyl-carbinol not produced. Good growth with no acid and no gas in dextrose, lactose, sucrose, mannitol, raffinose, salicin and xylose. Levulose, arabinose not utilised. Starch hydrolysed. Strict aerobe. Optimum temperature 30° C. Thermal death point about 51° C.

Pathogenic on *Ipomœa muricata* but not on *I. batata*, *Phaseolus vulgaris*, *Dolichos lablab* and *Vigna catjang*. A detailed paper will shortly be published.

Plant Pathological Laboratory,
College of Agriculture, Poona,
*July* 22, 1948.

M. K. Patel.

## ROLE OF PROTOZOA IN THE PURIFICATION OF SEWAGE BY "DILUTION"

In view of our earlier observations on the role of certain forms of protozoa (more especially *Vorticellids*) in the purification of sewage in artificial tanks[1,2] and under certain conditions of land irrigation,[3] it was of interest to study the occurrence and development of such forms in raw sewage before treatment. Examination of some 500 samples of sewage derived from different sources showed (*a*) that they generally contained cysts of the protozoa commonly found in the purification tanks; (*b*) that the sources of the cysts were traceable to washings containing soil, such as sullage and storm water, discharged into the sewers; (*c*) that when the sewage was 'weak', considerable numbers of active protozoa were present; and (*d*) that when the sewage was 'strong' or was diluted with discharges of alkaline or acid wastes in such proportions as to affect appreciably the pH value of the medium (or when the sewage contained certain other trade effluents), no active protozoan was seen.

Continued observations extending over a period of ten years at the Institute sewage works (dealing with domestic sewage) have shown that flow of 'weak' sewage in the sewers facilitated the development of protozoa, such as the species of *Vorticella, Epistylis, Paramœcium* and other smaller ciliates and flagellates, including *Amœba*; that the sewage samples collected at the works were occasionally found to contain nitrite in amounts ranging from traces to about 0·02 parts per 100,000.

Experiments were carried out by diluting raw sewage in varying proportions and keeping these diluted samples in shallow basins (in glass basins of diameter 3¾″ and depth 2¼″, and in porcelain troughs of diameter 8½″ and depth 4½″) and by examining the contents of the basins at frequent intervals for the micro-organisms and the oxidation changes. It was observed that in the 'weak' and diluted samples of sewage large numbers of protozoa developed. The predominant forms of protozoa were *Vorticella* sp. and *Paramœcium* sp., the former generally predominating in the earlier stages (upto about 36 hours); and in the later stages (after about 72 hours) other forms of protozoa, such as *Acineta* sp. and *Stylonychia* sp., also developed. A brownish deposit or sludge was found to be formed more especially in the basins which contained considerable numbers of protozoan cells; when the supernatants in the basins were decanted off and fresh water was added to the settled sludges, increasing amounts of nitrite and nitrate were produced. Thus it is of considerable interest to note in this connection that while the numbers of protozoa that develop in a given volume of sewage depend upon the amount of organic matter and dissolved oxygen

TABLE I

*Observations on the protozoal activity in freely exposed samples of 'weak' and diluted sewage*
(Results of chemical analyses expressed as parts per 100,000)

| Sewage-dilutions | At start: Oxygen absorbed from potassium permanganate in 4 hrs. | 24 hrs. after dilution: Oxygen absorption in 4 hrs. | 24 hrs.: Nitrite nitrogen (N) | 24 hrs.: No. of active protozoa per c.c. of the mixed liquor (mostly *Vorticella* sp.) | 48 hrs. after dilution: Oxygen absorption in 4 hrs. | 48 hrs.: Nitrite nitrogen (N) | 48 hrs.: No. of active protozoa per c.c. (*Vorticella* sp. and *Paramœcium* sp.) | 72 hrs. after dilution: Oxygen absorption in 4 hrs. | 72 hrs.: Nitrite nitrogen (N) | 72 hrs.: Protozoa |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 Sewage only .. | 4·52 | 2·80 | Nil | 4,000 | 1·76 | Nil | 600 | 1·64 | Nil | Practically no active *Vorticella* sp. but considerable numbers of *Paramœcium* sp. and other forms. The protozoa in basins 5 and 6 were comparatively few. |
| 2 Sewage+water 4 : 1 .. | 3·36 | 2·08 | ,, | 2,500 | 1·44 | ,, | 300 | 1·20 | ,, | |
| 3 Sewage+water 3 : 2 .. | 3·12 | 1·52 | ,, | 2,000 | 1·08 | ,, | 200 | 0·96 | Traces | |
| 4 Sewage+water 2 : 3 .. | 1·76 | 0·92 | ,, | 1,500 | 0·80 | ,, | 100 | 0·72 | 0·004 | |
| 5 Sewage+water 1 : 4 .. | 1·12 | 0·48 | Traces | 600 | 0·48 | Traces | 40 | 0·44 | 0·020 | |
| 6 Sewage+water 1 : 9 .. | 0·64 | 0·40 | ,, | 60 | 0·36 | ,, | 20 | 0·32 | 0·004 | |

Domestic sewage was employed for the above series of experiment. At the start of the experiment there was no active protozoan and there was no nitrite in the medium. The water used for dilution was distilled water stored in glass bottles; the amount of dissolved oxygen in this water was comparable to that in tap water.

The amounts of sludge formed in the different basins were directly proportional to the amounts of sewage matter present at the start; the sludges in all the cases appeared more or less brownish.

in the medium, the progress of nitrification is mainly dependent (within limits) on the amount of available oxygen which should be more than what is actually necessary for the maintenance of the aerobic organisms (Table I).

Similar experiments were carried out by diluting heat-sterilised sewage with distilled water and by introducing cultures of the protozoa and bacteria (as already indicated[1,2]) into the diluted samples; the results showed that the protozoa were much more efficient than the bacteria in bringing about the clarification and oxidation of sewage.

The above observations show the importance of certain ciliate protozoa, such as *Vorticella* sp. and *Paramœcium* sp., and excessive amounts of dissolved oxygen in the purification of sewage by 'dilution'. The evidence on the protozoal activity is of considerable value in explaining the mechanism of the dilution method of sewage disposal on which a large volume of literature has indeed accumulated.[4,5] It may be of particular interest here to refer to the recent note of Fowler[6] embodying some observations which he made long ago, while in Germany in 1913, on the importance of *Vorticella* in determining the extent of purification of sewage when discharged into river.

S. C. PILLAI.
Department of Biochemistry, R. RAJAGOPALAN.
Indian Institute of Scienee, M. I. GURBAXANI.
Bangalore, V. SUBRAHMANYAN.
*July* 22, 1948.

1. Pillai, S. C., *Curr. Sci.*, 1941, **10**, 84; *Ibid.*, 1942, **11**, 437. 2. Pillai, S. C., and Subrahmanyan, V., *Nature*, 1942, **150**, 525; *Ibid*, 1944,, **154**, 179. 3. Pillai, S. C., Rajagopalan, R., and Seshachar, B. R., *Curr. Sci.*, 1947, **16**, 254. 4. Letts, E. A., and Adeney, W. E., 'Report on the pollution of estuaries and tidal waters', Royal Commssion on Sewage Disposal, Fifth Report, 1908, Appendix VI. 5. Adeney, W. E., 'The dilution method of sewage disposal,' Cambridge Public Health Series, 1928, Cambridge University Press. 6. Fowler, G. J., *Science and Culture*, 1947, **12**, 405.

## AN APPEAL

THE Zoological Society of Bengal will publish a six-monthly list of papers published by the Zoologists in India, Pakisthan, Burma and Ceylon in each issue of the *Proceedings of the Zoological Society of Bengal* from September 1948 onwards. The Society earnestly seek the co-operation of all the Zoologists of the above dominions in the matter and request them to send copies of reprints of their papers to the Hony. Secretary of the Society at 35, Ballygunge Circular Road, Calcutta 19.

# REVIEWS

**Principles of Radar.** By Denis Taylor and C. H. Westcott. (Published by Cambridge University Press, 1948.) Pp. 141. Price 12 *sh.* 6 *d.* net.

The limitations of sight are great and generally beyond human control. Visual location devices fail under poor visibility condition. Radio waves penetrate fog or haze and darkness; they move with the speed of light and almost in straight lines; they can be produced at high power levels and can be received at low power levels with resonable freedom from interference. So radio waves are employed to locate objects at considerable distance. Hence the name radiolocation or radar.

The book is devoted to an exposition and survey of the principles underlying radar design. Out of ten chapters, the first eight chapters entail an exposition of the principles of primary radar. Principle and use of secondary radar have been discussed in Chapter Ten. The first chapter begins with an explanation of the principle of the method by bloc-schematic. The second chapter deals briefly with generation and reception of pulse modulated signals. In discussing about receiver noise, no mention has been made about solar noise and cosmic noise. This has been acknowledged by the author in the Preface. The examples on noise are interesting. The third chapter discusses about sender power, receiver sensitivity, nature of reflecting target, the gain and directivity of arrays and propagation condition. The four examples illustrating the method of calculating equivalent noise temperature of the aerial and maximum range of medium aircraft and bomber are very useful. Chapter Four deals with the practical aspects of radio ranging and discusses the accuracy attainable in such method. Chapter Five and Six present in a simple way the principle of plan position indicator (P.P.I.) and beam switching technique for the determination of azimuth and the principle of determination of the elevation of target. Chapter Seven discusses the two-dimensional scanning Detection of target position by reflexion of wireless waves becomes complicated due to the simultaneous arrival of unwanted reflexions from land irregularities, from surface of sea, etc. Chapter Eight discusses the undesirable echoes and the method to minimise them. Design constants of certain radar equipments used during war are mentioned in Chapter Nine The two Appendices giving standard formulæ, and method of calculating equivalent area of scattering, absorbing and echoing need special mention as they are very useful for ready reference to those who are engaged in design of radar.

The authors are to be congratulated for the clear exposition of essential principles of design which makes this book easily understandable. It is hoped that this book will be useful to those physicists and mathematicians who have knowledge of radio and who want to know about primary radar.

S. K. C.

---

**Elements of Strength of Materials.** 2nd Edition. By Timoshenko and G. H. Maccullough. (Published by D. Van Nostrand Co., New York, 1948.) Pp. 364. Price $ 4·00.

The subject covered in this volume is fundamental to the student, whether he is going to be a structural engineer designing structures, or a mechanical Engineer designing a machine part. The subject is an expanding one and there are fresh view-points emerging with the continuous research being carried on the various aspects of the subject. For instance, on 'Creep of metals' at high temperatures as well as fatigue of machine parts, our knowledge is still incomplete. So an intelligent appreciation of the fundamental principles is more important to the design student than a mechanical study on the application and use of empirical datas and formulas.

Judged from this view-point, this concise volume on the "Elements of strength of materials" is bound to be received as an up to date text-book on the subject. Prof. Timoshenko is well known for his numerous original contributions. In this volume he has retained the principal features of his classical volumes on "Strength of materials", where he had dealt with the elementary and advanced aspects of the subject in greater detail.

Starting with the determination of the tensile and compressive stresses in elastic members, the student is taken even at an early stage to a conception of combined stresses. Graphical methods for solution of combined stresses, using Mohr's circle is also explained clearly. The subject of rivetted joints, with a brief introduction to welded joints and the usual discussion of such joints in pressure vessels are presented in a way so as to bring out the fundamentals of these topics clearly to the student. He would however have to refer to advanced text-books for more information on the topics.

Both the integration method and area moment method for solving problems on deflection of beams have been given and a brief discussion has been added on the fundamentals of reinforced concrete beam design, without attempting to enumerate all the common formulas used in such design practice. In the treatment columns, instead of the usual empirical treatment, a short analysis from fundamentals has been given, indicating at the same time the place and use of the common empirical formulas.

A chapter on the strain energy theory and its application to statically indeterminate problems is given at the end. There is also a short chapter on mechanical properties of materials and the methods of testing with standard testing machines. The subjects of

creep of metals at elevated temperatures and the fatigue of metals have been discussed in some detail. A brief chapter on photo-elasticity and an Appendix containing a discussion of moments of inertia of sections, with tables of properties of standard sections are additional features in the volume.

On the whole, the author has given in one concise volume (of fourteen chapters), an idea of the fundamentals of the subject drawing the attention of the student at the same time to the limitations in the application of the theories and formulas. A selected number of illustrative problems and a large number of problems for student solution add to the usefulness of this volume as a text-book.

The fact that the second edition, edited with some improvements in 1940, has been already reprinted eighteen times over before 1948, speaks well for the popularity of the book, and I feel sure it will attract wider attention from the Engineering Colleges and Technical Institutes in India.

V. S. JAYARAMAN.

---

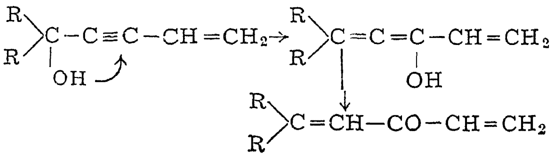
**The Chemistry of Acetylene and Related Compounds.** By Ernst David Bergmann. (Interscience Publishers, Inc. New York, 1948). Pp. 108. Price $ 3·00.

Coal as a possible raw material for petroleum is a topic of absorbing interest in the present-day petroleum politics and it is therefore to be expected that acetylene, as the most versatile starting material obtainable from coal, should have considerable attention focussed on it. During the last two decades interest in the chemistry of acetylenic compounds has markedly increased and advances in the industrial sphere have brought many fascinating problems to the theoretical organic chemist. Literature on the chemistry and technology of acetylenic compounds, however, is widely scattered and monographs on the subject are few. The book under review which is a reprint of three lectures delivered by the author at the Polytechnic Institute of Brooklyn is, therefore, a timely contribution to the study of the subject. The copious references to literature given throughout the book would also stimulate and help further studies.

In the first lecture the author starts with a consideration of the thermo-chemistry of acetylene and shows how considerations of the free energies of acetylene at higher and lower temperature levels—acetylene forms an exception in that its free energy decreases at higher temperatures—provide the basis for the modern attempts to produce acetylene by high temperature (1200°-1500° C.) cracking of hydrocarbons such as methane or natural gas. As alternatives to the classical carbide process, the two methods extensively studied in recent years—the thermal cracking, and the electric arc process developed chiefly in Germany—both show this feature. The consumption of electric energy is shown not to differ materially from that for the classical carbide process, so that the factor which determines the type of process to be used in any particular instance is more the availability of the material than the cost of the current. The results obtained with the electric treatment appear also to be superior, the yield of acetylene being nearly 45 kilograms from 100 kilograms of the initial gas. The molecular structures from infra-red and Raman spectra and calculations of the length and strength of the C-H bond and its other peculiarities in acetylenes are then described, and on the basis of these, explanations given of the many characteristic reactions of which acetylene and its derivatives are capable. The complete picture which is given of the mechanism of many unusual types of synthesis with CO, ketens, dienes, HCN, diazomethane, sulphur, etc., enabling us to understand their theoretical significance, forms a valuable feature of the first chapter.

The second lecture is devoted mainly to a survey of the reactions that could be carried out with alkali acetylides and their copper analogue as well as those with silver, mercury and copper salts as catalysts. Reppe's researches concerning the addition of formaldehyde using copper acetylide on a carrier under well-defined conditions, and the variety of industrially important compounds whose preparation is thus made possible, are described and a whole table is devoted to compounds obtained by the interaction of acetylene and formaldehyde. The rest of the lecture is devoted to a consideration of Weizmann's extensive work on the addition of acetylene to ketones and aldehydes in a suitable solvent medium containing potassium hydroxide. These condensations make available from acetylene all the monomers which the modern industry of high polymers requires, and a large number of new uses to which they might be put, though of lesser promise, are also indicated. Since acetylene itself gives acetone in as high a yield as 93 per cent. under certain conditions, it provides all the substances required for the production of the known synthetic rubbers. Reppe's vinylation reaction also makes easily accessible many new types of substances from which, by polymerisation with selective agents like boron trifluoride, etc., highly viscous oils, plastics, brittle resins or rubber may be obtained.

The third lecture describes the polymerisation reactions of acetylenic compounds, especially the formation of lower polymers like vinylacetone, divinyl acetylene, cyclo-octatetraene, etc. These reactions are sought to be correlated with the electronic configuration of the acetylenes as revealed by physical measurements. Thus the hydrogenation of the vinylacetylenic carbinols is shown to exhibit the peculiarities of the acetylenic system with all the peculiarities introduced by conjugation. The OH-group can undergo anionotropic rearrangement to divinyl ketones which are extremely prone to polymerisation and yield technically important permanent adhesives:



Equally prone to isomerisation and polymerisation are the tertiary chlorides corresponding to the alcohols, and from the behaviours of those compounds the interesting deduction is made that the triple bond is only a variant of the olefinic double bond. It can participate in a conjugated system with a double bond—*i.e.*, it has electrons which are free and mobile enough to cause resonance phenomena.

The chemistry of acetylenic compounds is still a little known field except to the specialist and interest in the subject deserves to be more widespread. The author has in this little monograph of 104 pages collected all the important material and presented them in a concise and readable form. Very few aspects of importance in acetylene chemistry seem to have been left out although one feels that some more space might have been allotted to the preparative side and to a fuller description of such familiar reactions as hydration, ozonolysis, etc. Another minor criticism which might be made is that the facts presented in the book would have been thrown into better perspective if the material were arranged not in the present form of lectures but in the sequence of historical growth of the subject or of their technical importance.

The book is neatly got up and printed and is remarkably free from errors. The references given at the bottom of every page are fairly exhaustive and the theoretical treatment is lucid and lights up many an obscure point in acetylene chemistry. Much praise is due to the author for writing the book which meets a real need.

B. B. DEY.

---

**The Theory of Valency and the Structure of Chemical Compounds.** By P. Rây. (Indian Association for the Cultivation of Science, Calcutta, 1946). Pp. 81.

For some of us who have listened to the Presidental Address of Prof. Rây on the "Doctrine of Valency and the Structure of Chemical Compounds" at the Indian Science Congress Session, 1932, there is little wonder that he should have given such a lucid account of the development of the modern concept of valency and structure of Chemical Compounds. The present work constitutes a summary of the Cooch-Behar Professorship Lectures delivered by the author in 1945 before the Indian Association for the Cultivation of Science. The development of theory of valency has been presented right from the times of Dalton upto the present moment. Although the chemist is very keen in knowing the latest developments in the theory of valency, yet his enthusiasm is often quenched when he sees the treatises on valency full of higher mathematics. It is highly gratifying to note that Prof. Ray has deliberately omitted the mathematical treatment of the subject without, at the same time, sacrificing the fundamental principles involved in the theory.

The first two chapters give a brief historical review of the various stages of the theory of valency including Werner's Theory of Complex Compounds and Thiele's Theory of Partial valency. The third chapter consists of the fundamental principles of electronic theory of valency as developed by Kossel, Lewis, Langmuir, Sidgwick, Rây and Pauling. The electronic structures of atoms and molecules form the subject-matter of the IV Chapter. The principles of quantum theory and their application to the theory of valency have been very well summarised in this chapter with a large number of examples, many of which have been investigated by the author and his co-workers. The V Chapter is devoted to the application of the principles of resonance to the theory of valency. The resonating structures of benzene, carboxyl group, nitrous oxide, boron hydrides and ferrocyanide have been critically examined. The relationship between the absorption of light and the resonance in the molecules, is also given in this chapter. The last chapter deals with the valency in ionic crystals. Two printer's mistakes on pages 16 and 56 have to be rectified in future editons.

Prof. Rây is one of the very few in India who have made substantial contributions to our knowledge in the field of Inorganic Chemistry in general and structure of complex compounds in particular and coming as it does from him, this work is bound to impress the readers, of his wide knowledge and masterly treatment of the subject. The book will be of special interest to all advanced students and research workers in Inorganic and Theoretical Chemistry.

M. R. A.

---

**Chemical and Physical Investigations on Dairy Products.** By H. Eilers, R. N. J. Saal and M. Van der Waarden. (Elsevier Publishing Co., Inc., Amsterdam and New York, 1947.) Pp. 215. Price 21 *sh*.

The book contains interesting data on some of the problems of dairy industry re-examined with newer technique. Thus the authors are able to throw new light, on things which are sometimes assumed to have been proved conclusively.

In the first part of the book the composition and structure of the caseinate-phosphate phase in milk and and in heated milk has been studied from different angles. These results have been applied to explain the phenomenon of coagulation of condensed milk. It has long been accepted that the coagulation of condensed milk during the process of sterilization and storage is due to a shift in the salt balance. It has been shown in the present thesis that this coagulation is due to the denaturation accompanied by flocculation of the dispersed phase, with the ultimate formation of spongy aggregates. The dispersion of denatured protein is influenced by several factors like change in pH; increase in the concentration of dispersed phase and of salts, and state of phydration of the proteins. Citrate or phosphate, which are added as stabilizers, prevent coagulation of condensed milk due to their ability to prevent flocculation of denatured proteins. The theory also gives a pausible explanation for the different behaviours of unsweetened and sweetened condensed milk.

The second part of the book describes results of study of oxidation-reduction potential of milk and of butter. The variation in $E_h$ of milk with season was studied and some indication has been given of the relation between $E_h$ and ascorbic acid content of milk. From a study of the $E_h$ of butter, a phypothesis is put forth to explain the likely stages in the progress of deterioration of butter stored at low temperatures. It has also been indicated that raw and pasteurised milk can be protected from the development of oxidised flavour, without the addition of any antioxidants, by adding a small quantity of boiled milk.

Lastly, the authors have studied the process of development of rancidity in butter. It is shown that, contrary to the accepted theory, development of fishy flavour in butter is independent of the presence of trimethylamine. Compounds which cause defects in the taint of cold-storage butter occur in the volatile components condensed at $-196°$ C. The offending flavour substances are shown to be compounds of C, H and O, and are largely of the nature of unsaturated $C_4$ to $C_8$ aldehydes. A close correlation was found between the flavour score and peroxide values of butterfat.

The book contains a comprehensive bibliography and though it deals with a highly technical subject like the physical and chemical properties of milk, makes a fascinating reading. It will be a useful supplement to the available standard text-books on the subject. The book has been printed legibly with very few typographical errors.

N. N. D.

---

**Fundamentals of Comparative Embryology of the Vertebrates.** By Alfred F. Huettner, (Macmillan, New York, 1948). Price 20*sh.* net. (Pp. xiv + 1-416, 168 text illustrations.)

This is an important contribution to the teaching of Vertebrate Zoology. Originally published in 1941, it is the seventh reprinting of the work that is before us which shows that it has deservedly become popular. Comparative embryology of Vertebrates is always a difficult discipline in the class-room both to the student and the teacher. Many text-books are in the field written by leading authorities in vertebrate morphology but the difficulties of the students in taking a living interest in this essential branch of biology have always remained. Professor Huettner has put in book form the course in elementary comparative embryology which he has been giving for a period of over twenty years and in writing this book his guiding principles have been that, "text-books should be fluently readable, avoid discussions of controversial theories, be well and profusely illustrated and have the illustrations integrated with the text".

The first four chapters are introductory in nature, dealing with the protoplasm and the cell, the development of sex, chromosomes, gametes and fertilization. This section which is well illustrated and takes into account modern developments in biology should prove an excellent introduction not merely to embryology but to any course of lectures in biology, but emphasis is rightly laid on the developmental aspect. The remaining fifteen chapters are devoted to descriptive accounts of the types chosen, *viz.*, Amphioxus, Frog, the chick and the mammal. The descriptions are carefully written and aptly illustrated; the value of the accounts of development lies not in the new information available but in the extremely lucid and workmanlike presentation of the themes in a manner that is stimulating to the serious student. Where contradictory information is available, this is promptly indicated, as for example, on the question of the germ layer that contributes to the formation of the notochord in Amphioxus which most teachers even now assume to be endodermal in origin. In the description of the frog (as also in the other types) it is noteworthy to find attention given to the history of the egg before fertilization which is omitted in most books and, in the account that follows, the author, from his own material, has been able to show that in the various species of frogs obtained by him in America, the neurocœl is never connected with the gastrocœl by a neurenteric canal; similarly there is no neuropore delaying the union of the neural folds in the anterior part of the embryo. These and other corrections have been possible, thanks to the method adopted in the writing of the book. In every case the description and illustrations have been based on the preparations made by the author. The method followed in the illustrations cannot be too highly praised. They have all been done from reconstructions and projections from material prepared by the author paying attention to the value and importance of the three dimensional picture in indicating developmental relationships. All the illustrations are in black and white and are easily reproducible in spite of the 'solidity' and the wealth of details shown. They are refreshingly new and the success of the work is largely due to the high quality of the illustrations.

While this new technique has given much illustrative material in the study of embryology of the frog and Amphioxus, it is natural that in so well described a subject like chick embryology the author has little that is new to offer but, even here, the integration of the text with the original illustrations given is in keeping with the painstaking procedure adopted in the earlier sections. A noteworthy feature in the treatment of mammalian embryology is the selection of human development as the main theme. Descriptive and illustrative material for this have been taken from original papers which are not easily accessible. The value of this part of the book is also enhanced by the very readable account of the modern concepts of hormones and their role in the physiology of reproduction. To those who do not have the time to seek original literature and understand current ideas in this field of work where there is so much that is controversial, a clear statement of the more stable ideas of hormonal regulation of reproduction, as given in this volume, would be particularly welcome.

Certain readers would no doubt deplore the absence of any facts relating to experimental embryology but there is much to be said in favour of the author's attitude to confine the work to the morphological side because, as rightly indicated by him, students of elementary embryology are not well enough prepared to understand experimental data until they have acquired a sound knowledge of the morphological side of development. The absence of references to important original sources (except in the case of borrowed illustrations) which could be pursued by the serious student will also be regretted by many readers. But these cannot be put down as defects in the case of a treatise primarily intended for the classroom where it is sure to become a popular and essential aid for learning vertebrate embryology.

N. K. PANIKKAR.

**A Catalogue of Insecticides and Fungicides, Volume I. Chemical Insecticides.** Compiled by Donald E. H. Frear, ph.D. Published by Waltham, Mass, U.S.A. The Chronica Botanica Co., Calcutta, Bombay and Madras; Macmillan & Co., Ltd., 1947. Pp. 203. Price $ 6·50.

An attempt has been made by Dr. Frear in this Catalogue to list and classify upto January, 1944, all known chemical compounds (about 10,000), which may possess insecticidal or fungicidal properties. A new classification based on a 'Code number' system has been devised by the compiler. Organic Compounds possessing a similarity of chemical build are listed under the same constituent group. There are sixteen such constituent organic groups, which are arranged in the order of decreasing complexity. The inorganic compounds are divided under the main heads of cations and anions, and the listing under each head is done in an alphabetical order.

Under the referred code number, the name and the empirical formula of the compound is given and side by side its degree of toxicity to particular insects has also been mentioned.

This catalogue is the outcome of painstaking and arduous work and should be regarded as an indispensable reference book for such as are engaged in toxicological or fungicidal work.

This great work of compilation does not include references to many other recently discovered organic chemical compounds. Since the World War II, tremendous advancement has been made in the chemistry and toxicology of organic insecticides and in order to make this Catalogue complete, their inclusion is absolutely necessary in a supplementary list. It is trusted this will be done by the author before long.

A. S. SRIVASTAVA.

# SCIENCE NOTES AND NEWS

## The Indian Association for the Cultivation of Science (1876-1948).

The report on the working of the Indian Association for the Cultivation of Science is made in three parts.

Part I traces the history of the Association from its inception in 1876 at No. 210, Bowbazaar Street, Calcutta, due to the zeal and endeavour of Dr. Mahendra Lal Sarcar to its present dimensions. The large share played by public munificence and Government patronage is acknowledged.

Part II describes how the activities of the Association of the early days, confined mainly to the dissemination of scientific knowledge through popular lectures changed gradually to the spearhead of research so as to take a momentous turn in 1907 when Sir (then Mr.) C. V. Raman joined it as a member and began his investigations as a regular part-time honorary research worker.

The research activities of the Association between 1907 and 1933 under the dynamic leadership of Professor Raman are described in great detail, with a picture of the first spectrogram obtained by him in 1928 of the now famous Raman Effect. This is followed by an account of the great progress made under Sir (then Mr.) K. S. Krishnan as Mahendra Lal Sarcar Professor between 1934-42.

The section concludes with an account of the research work under Professor K. Banerjee as Mahendra Lal Sarcar Professor between 1943-48.

Part III is in the nature of an appeal to the public for funds, to enable the Association to carry out its schemes of development.

The report is profusely illustrated with photos of the founder, royal patrons and distinguished members and Professors.

## Department of Scientific Research

The Government of India have set up with effect from June 1, 1948, a Department of Scientific Research. The Department will work under the Prime Minister. It will take over the Council of Scientific and Industrial Research, the Board of Atomic Research and such other functions of the Director, Scientific and Industrial Research which the Government might decide to transfer to it.

It will also co-ordinate the scientific activities of the other Ministries. In its co-ordination work, the Department will be assisted by a Co-ordination Committee consisting of prominent scientists.

## National Metallurgical Laboratory

Dr. George Sachs, Director, Research Laboratory for Mechanical Metallurgy and Professor

of Physical Metallurgy, Case Institute of Technology, Cleveland, Ohio, has been appointed Director, National Metallurgical Laboratory, Jamshedpur. He will assume his new duties on October 1, 1948, although he is now in the part-time service of the Council of Scientific and Industrial Research helping Dr. G. P. Contractor securing equipment and visiting important centres of Research in Europe before his return to India.

The National Metallurgical Laboratory is one of five new governmental research laboratories recently established by the Indian Council for Research and Development, the others being the National Chemical Laboratory, the National Physical Laboratory, a Fuel Research Station, and a Central Glass and Ceramics Research Institutes.

The National Metallurgical Laboratory will cover all aspects of metallurgical research, both fundamental and applied, and will also carry out research work on ores, minerals and refractories. Close co-operation with the modern research laboratory of the nearby Tata Iron and Steel Company will be established. Special consideration will also be given to research on non-ferrous metals such as copper, aluminium, manganese, zinc, titanium and beryllium, of which India has abundant ores, and for the production of which large power resources are available. In the initial stages of the work of the laboratory, the special and urgent needs of India will require particular attention. The N.M.L. therefore includes a well-equipped Technological Section which will permit establishing and operating pilot plants. On long-term research of a fundamental nature, the various National Research Laboratories will work in close co-operation.

It is planned at present to provide 85,200 square feet of laboratories. Ample space is also available for future extension. The main building will have a front of 480 feet. Detailed information may be secured from a pamphlet "Revised Scheme for the Establishment of the National Metallurgical Laboratory, published by the Council of Scientific and Industrial Research, Delhi, 1946.

## Atomic Energy Commission

It has just been officially announced that the Government of India has decided to set up an "Atomic Energy Commission" under the distinguished chairmanship of Dr. H. J. Bhabha, Director, Tata Institute of Fundamental Research, Bombay. The commission will be entrusted with the task of surveying the atomic mineral resources of the Dominion and with the responsibility of promoting research in Institutes and Universities. Special steps are expected to be taken to encourage advanced teaching and research in Nuclear Physics in the Universities.

## Radio-Cobalt as Cancer Cure

Radio-active cobalt may in a few years replace radium in the treatment of cancer, according to Sir John Cockcroft, Director of Britain's Atomic Energy Research Establishment at Harwell.

Apart from the obvious advantages of cheapness and relatively unlimited availability, radio-cobalt—as it is called—may prove less potentially dangerous than radium when applied to the human body. Its period of intense radio-activity is limited and measurable. But at least another year will pass before there is enough radio-cobalt for anything except research.

When Harwell's new uranium pile, on which preliminary tests began a few weeks ago, is in full operation, it is expected to produce all the radio-active material required in Britain.

## Refrigeration of Foods

Over 60 new cold storage plants for the preservation of seed-potatoes and perishable foodstuffs like fruits, vegetables, milk products, eggs, meat and fish and a number of ice manufacturing plants are likely to be installed in India before the next hot season sets in. Located at about 40 different centres in various parts of the country, these plants will have a capacity varying from 3,000 maunds to 30,000 maunds for a single unit, with a total capacity of over a million and a quarter maunds. It will then be possible to preserve enormous quantities of perishable and to spread out their supply over the whole year, if necessary. At present the country has only about a dozen such plants for civilian use.

## Popularising Refrigeration

Every year the country suffers heavy losses on account of deterioration in the quality of perishable foodstuffs before marketing or on account of these having to be sold at uneconomical prices in glut markets. "Refrigerated warehouses," as the cold storage plants are known in Western countries, are believed to be the best means known to science for converting these heavy losses into profits. It is estimated that these losses at present in the case, for instance, of seed-potatoes are as high as 50 per cent. Cold storage plants, experts claim, can help to bring down this loss to something like five per cent.

The Central Ministry of Agriculture, which has a special branch called the Refrigeration Development Division, is taking keen interest in popularising the idea of preservation of foodstuffs through refrigeration among the growers with a view ultimately to augment the total availability of foodstuffs in the country all the year round and at the same time protecting the growers from avoidable losses.

## International Commission on Large Dams

A Delegation of eight Indian engineers under the leadership of Mr. A. N. Khosla, Chairman, Central Waterpower, Irrigation and Navigation Commission, New Delhi, is shortly leaving for Sweden to participate in the third Plenary Session of the International Commission on Large Dams. Mr. Khosla is also the Vice-President of the International Commission. The delegation will include Rai Bahadur P. C. Aggarwal, Chief Engineer, United Provinces,

Mr. S. R. Krishnamurthi of Madras, Professor M. S. Thacker, Head of the Power Engineering Branch of the Indian Institute of Science, Bangalore, and officers of other administrations. Mr. N. D. Gulhati, Secretary, Central Board of Irrigation, Simla, will be the Secretary to the delegation. This is the first meeting of the International Commission on Large Dams after the last war, and apart from participating in the discussions at the Plenary Session all the delegates to the meeting will be taken round hydro-electric and industrial works in Sweden.

## Forest Ranger College at Dehra Dun

The Quinquennial Report of the Indian Forest Ranger College for the period 1941-46 which has just been published reveals that the College has expanded from its initial strength of 34 to one of 113 in 1945-46. It may be of interest to know that the College provides a two-year course in Sylviculture, Forest Management, Protection, Forest Mensuration, Forest Utilization, Forest Law and allied subjects such as, Forest Botany, Forest Pathology, Mycology, Forest Entomology, Geology, Soil Science and Forest Surveying, in addition to intensive practical training and educational tours. Admission is strictly limited to students who have passad out the Intermediate Examination in Science of an Indian University and deputed by Provinces and States with guarantee of employment on the successful completion of the course.

## Royal College of Veterinary Surgeons

The Royal College of Veterinary Surgeons, London, has agreed to grant certain concessions to graduates and licentiates of Indian Veterinary Schools who went to take the diploma of M.R.C.V.S. of that College.

Holders of veterinary degrees of the Universities of Agra, Bombay, Madras and Nagpur will be required to take the final examination *plus* one extra subject after a minimum of two years' attendance at an affiliated veterinary school, but some schools may require a little longer than two years in order to fit in with their courses of instruction. Holders of the diploma of Madras Veterinary College (G.M.V.C.), if in possession of an Inter B.Sc., will be granted exemption from the first professional examination in the diploma of M.R.C.V.S.

The Royal College is also taking steps to have its charters altered in such a way as to enable the graduates of recognised universities to take its post-graduate diplomas which at the moment are reserved exclusively to persons who are members of the College.

When the Veterinary Surgeons Bill, which is now before Parliament, becomes law, there will be increased facilities for post-graduate education at various universities in the United Kingdom, and in addtion two new veterinary schools will be created at Bristol and Cambridge which will help to alleviate the present difficult places at veterinary schools.

## Substitute for Linseed Oil

Owing to the continually rising price of linseed oil British chemists have been forced to look for substitutes. Besides such natural alternatives as tung and rubber seed oil, a British firm has been experimenting with mineral-based oils of similar characteristics.

These experiments have now resulted in the discovery that styrene products can be used to replace linseed oil in a wide range of products. A plant is being erected for the manufacture of styrene from coal and when this is in full operation the price of the new oil may be as low as Rs. 304-12 a ton. The latest price for linseed oil from the Argentine is Rs. 2,662 a ton.

## Geomagnetic Storms

Some details of the Geomagnetic Storms as recorded at the Alibag Magnetic Observatory are given in the following table in which $t_0$, $t$ represent the time (I.S.T.) of commencement of the disturbance and its intense phase respectively and T the duration of the intense phase expressed in hours. The ranges in the three different elements (D, H and V) of the earth's magnetic field have also been given, D, in minutes of arc, H and V in $\gamma$ where $1\gamma = 10^{-5}$ gauss. The maximum $k$-indices ($K_M$) recorded during the disturbances have also been given.

| Date | $t_0$ | $t$ | T | Range | | | $K_M$ | Nature of commencement |
|---|---|---|---|---|---|---|---|---|
| | | | | D | H | V | | |
| | h. m. | h. m. | hrs. | min. | $\gamma$ | $\gamma$ | | |
| April 6–7 | 09 28 | 22 19 | 5 | 4·4 | 155 | 54 | 5 | Sudden |
| April 21–22 | 04 36 | 07 06 | 9 | 7·7 | 167 | 88 | 5 | Sudden (Indistinct) |
| May 9 | 12 52 | 12 52 | 4½ | 5·1 | 185 | 89 | 5 | Sudden |
| May 15–17 | 04 53 | 04 53 | 13 | 7·4 | 159 | 84 | 4 | Sudden |

## Modern Arboretum

Dr. Frans Verdoorn, Managing Editor of *Chronica Botanica* spoke on June 17, before the southern California Botanical Society, at the Rancho Santa Anita, near Pasadena, on "The Modern Arboretum, A Center of Regional, Botanical and Horticultural Synthesis". Dr. F. W. Went, Professer of Biology at the California Institute of Technology, and Chairman of the Trustees of the Los Angeles County Arboretum Foundation, outlined the plans of this foundation which will develop a modern 114 acre arboretum, with educational, horticultural and research departments, at the site of the historical Reid and Baldwin estates at the Rancho Santo Anita.

Editor: M. Sreenivasaya, B.A., F.I.I.Sc., F.A.Sc.
922-48 Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore

Current Science

Vol. XVII] SEPTEMBER 1948 [No. 9



# THE SCIENTIFIC AND ECONOMIC ASPECTS OF PROHIBITION

AMONG the many ameliorative measures promulgated by the Congress Ministry when it took charge of the destinies of the Nation in the various Provinces, Prohibition remains one of the most courageous, farsighted and praiseworthy legislations. The measure is one which was dearest to Gandhiji and is calculated to remove one of the most potent causes for the poverty and unhappiness of the less fortunate classes of the population in the industrial and rural areas.

The introduction of Prohibition, while it raises the moral stature and promotes the material well-being of the common man, has led to a substantial, if not a serious, reduction in the revenues of the State, running to many tens of crores of rupees. During the last Congress Ministry Sri. C. Rajagopalachariar (now His Excellency the Governor-General of India), then Prime Minister, Madras, sought to meet the difficult financial deficit by the introduction of the Sales Tax, which proved successful in meeting the deficit to a considerable extent.

Since the 15th August 1947, enlightened opinion in the country has been growing that the effects of drink on the impoverished masses is too serious to admit of any futher delay in forging ahead with the remedial measures which include Prohibition. Prohibition as a programme of National rehabilitation and reconstruction has, therefore, been accepted as a measure demanding immediate attention. It has the enthusiastic backing of all our elder statesmen.

Prohibition has, however, raised issues which, we are afraid, have not been fully appreciated and satisfactorily tackled. In the present context of social, educational and industrial regeneration of the country for which ambitious plans have been formulated, the serious financial deficit which confronts Provincial Governments will be admitted as exceedingly unfortunate and embarrassing. In view of the present low-earning capacity of the average Indian citizen, there are very definite limits as to what can be got out of him by way of fresh taxation.

The tapping, the transport and the distribution of the toddy liquor together constitute a prosperous enterprise which

provides employment to a large number of tappers—a class of hereditary professionals who are skilled in the technique of obtaining the juice from the palms - not to speak of the personnel employed in the transport and distribution of toddy, which is carried on by a chain of middlemen, petty contractors and shop-keepers. The interests of this well developed and closely knit organisation is now at stake. The men connected with this trade amount to several hundreds of thousands and are now threatened with the prospect of losing perhaps their only means of livelihood by the introduction of this measure.

It seems to us that the stage has been more or less set for men of Science and Technology to accomplish two things: first to keep the traditional organisation functioning and prevent a crash in its structure, and (2) to discover a process by which palm juice could be converted into a valuable revenue-yielding product.

The deleterious effects of toddy (fermented juice of palm) and the arrack (the distilled liquor), which are the forms most commonly indulged in by the poorer classes of addicts, are due to their alcoholic content. The unfermented juice of the palm generally known as sweet toddy, has been recognised from times immemorial to constitute an invigorating tonic beverage prescribed by practitioners of indigenous medicine for anæmic and syphlitic patients during convalescence. Palm juice is used for making a crude form of *gur* (crude sugar) by boiling down the juice in open pans; the dark residue cast into cubes, is commercially available in restricted amounts and is employed by Ayurvedic and Unani physicians as a sweetening vehicle for many of their tonics. It enjoys the reputation of being therapeautically far superior to the *gur* made from cane juice. Considerable quantities of palm *gur* was being used as raw material in refineries for the manufacture of sugar and with the advent of Prohibition larger quantities of this product are likely to be made available since many of the Provincial Governments have already inaugurated a scheme for the manufacture of *gur* from palm juice as one of the practical solutions to the problem of its economic utilisation. There is little information regarding the costs of manufacture, whether the returns compare favourably with those of the cane *gur*.

The ideal to be aspired in the solution of this problem is to convert palm juice into a beneficent product as valuable as fermented toddy or distilled arrack has been from the point of view of the yield of revenue to the State but without the evil effects of the intoxicant on the social life of the people. If the juice could be utilised for manufacturing a product like a vitamin-rich and nourishing concentrate like malt extract or an antibiotic like penicillin, it would constitute a valuable achievement. Since the juice is known to contain on an average, 10-12 per cent. of cane sugar, the product should provide an ideal raw material for many of the fermentation industries, including those pertaining to the production of citric and lactic acids. Whatever be the product proposed to be manufactured, we are initially confronted with two major limitations: the first difficulty arises out of the inherent quality of the juice, *viz.*, the extreme rapidity with which it gets infected and ferments, the second one is connected with the circumstance that the palm trees do not occur as continuous and uniformly distributed plantations but appear as fortuitously scattered groups in widely separated and sometimes difficultly accessible areas. This situation renders the tapping, collection and transport of the juice difficult, time consuming and expensive.

The problem of collecting the material from widely scattered areas and preserving it from spoilage until it reaches a central factory where it is to be further processed, demands the immediate attention of those interested in a rational solution of the problem. The Government of Bombay have recently instituted the award of a prize of Rs. 10,000 for the discovery of a preservative which would effectively keep the juice in its natural state without any "spoilage" and without lowering or abolishing any of its "goodness".

We understand that this problem is being vigorously tackled both at the Indian Agricultural Research Institute, New Delhi, and at the Indian Institute of Science, Bangalore. Investigations at Bangalore have revealed that freshly drawn and carefully preserved juice contains adequate amounts of the more important components of the B-complex and is nutritively and therapeautically comparable to malt extract. These preli-

minary findings lend convincing support to the time-honoured belief in the efficacy of palm juice as a health giving tonic. It is to be expected that the researches now under way may lead to an entirely new approach to the problem of the economic utilisation of the juice.

There is one aspect of this problem which merits elucidation in some detail. Palm juice as a raw material for the manufacture of cane sugar offers many exceptional advantages. First, the expensive crushing machinery which is an essential part of every cane sugar manufacturing enterprise, can be eliminated in the case of a factory devoted to the manufacture of sugar from palms. Palm juice is the result of just "tapping" which of course is a highly skilled operation. Secondly, since the juice is comparatively free from chlorophyllous and other pigments, the process of clarification is considerably simplified. Thirdly, the juice is considered to be free from sucrose inverting enzymes, which minimise the formation of molasses. Fourthly, the annual cost of cultivation attending the raising of sugarcane crops is entirely eliminated. To-day, palms constitute a free and generous gift of Nature; they flourish without any attention in some of the most inhospitable and barren soils and continue to yield the saccharine juice for 60-70 years. With a little attention and care the useful life of the palm could perhaps be extended and the yield of juice augmented. These are problems for the future when the palm will come to be recognised as the sugar yielding perennial.

It is interesting to recall that as early as 1901, a company (The Khandwa Sugar Manufacturing Co.) was organised in the Central Provinces to promote the production of palm sugar. The causes which led to the failure of the enterprise are obscure and it would be interesting and instructive to investigate them. Exact data are not available on the question of the yield of the juice per tree per season. It is roughly estimated that a single palm, if well developed, might yield sufficient juice to make a maund of sugar which, at the current rate, would cost about Rs. 35. If a hundred palms can be optimally stocked in an acre of land, the annual gross revenue per acre would amount to a surprising figure of Rs. 3,500. These data have to be checked but they serve to emphasise the potentially remunerative aspects of the enterprise. A conservative estimate of the number of palms in the country puts the figure at 4 crores; this potential source of natural wealth should be exploited. We would strongly urge the Provincial and State Governments interested in this perennial crop, to constitute a Central Advisory Board to devise ways and means by which this important source of raw material could be economically capitalised in support of Prohibition and the services of the present trade organisation mobilised on modern lines without creating unemployment in its ranks.

## DUTY OF SCIENTISTS TO THE STATE

ADDRESSING the members of the Gymkhana of the Indian Institute of Science, during his visit to the Institute on 21st August 1948 His Excellency Sri. Rajagopalachari referred to the immensity and the urgency of the problems of rehabilitation and reconstruction confronting Independent India. He said, "Without the help of science, our leaders will not be able to do much for the country. That is why the Prime Minister continually and, if I may say so, wistfully looks up to the help of science so that we could be enabled to do something for the people in spite of all our difficulties. I want you to realise your responsibilities. You are not simply here studying for a career. That might have been so before. Now you are studying in order to help the Government."

Proceeding, His Excellency declared, "I do not think that anywhere in India they have an Institute of this character and, if I may say so, of this size also. It has grown very big, it has grown very important. You have in your hands all science so to say and it is for you therefore to realise this fact that the leaders in the Government of India are looking up to you. You must therefore study things with that realisation of your importance. If you do that, I am sure that in the course of the next 12 years the work of the Government will have been made much easier than it is now and they can get men to help them in all directions."

Concluding, His Excellency said, "Do not ask, what will be my salary and allowance. Your salary is service to the country, your allowance will be the smiles of the Government when you do well. If you realise this and find joy in it, I am sure that everything will be satisfactory. When you make an experiment in the laboratory, when you find the results successful and you are able to put them down on paper, you feel joyed apart from what you can get in rupees, annas and pies. Your studies as a whole are like experiments in the laboratory devoted for the service of the country and it must be a joy to you, indeed, if you have succeeded in your experisments."

## DIAMONDS IN INDUSTRY

"DIAMOND Tools" was the subject of an interesting lecture by Sir C. V. Raman, Kt., F.R.S., N.L., in the Chemical Engineering Society of the Indian Institute of Science, Bangalore, on the 18th September 1948. Sir C. V. Raman referred at first to the numerous theoretical and experimental investigations on the subject of diamond, by himself and his collaborators, extending over a period of nearly 20 years and actuated only by the desire for fundamental knowledge. He remarked that his recent tour of the United Kingdom and the U.S.A. tended to confirm the views he had always had that an intensive study of the structure and properties of diamond would prove of the utmost importance not only for the pure branches of Science but for industry and technology as well; for, he said, industry especially in the U.S.A., has found uses already for diamond almost in its every department. He explained how for example diamond dust is utilised in the spectacle-making industry for cutting, grinding and polishing at a surprisingly fast rate; also, he described the use of diamond in the making of special high grade precision tools needed for shaping, in the manufacture of billiard balls, printing rollers, the burnishing of steel watches and so forth. He added that specimens of the crystal were utilised as dies, for drawing wires as thin as 10 $\mu$ after drilling through them an optically perfect hole of the required size and special shape with the aid of microscopes. He emphasised the fact that industry in U.S.A. has reached a stage when high class precision work demanded the use of diamond almost everywhere and moreover, found it worth while to employ high class material for the purpose.

He said that increasing demand for the utilisation of diamonds in industry did not in any way come to him as a surprise because, he said, mechanical properties of diamond, including especially its great hardness and compressive strength, warrant its extensive use in technology. Incidentally, he referred also to the vectorial variations in hardness which have come to light in the process of polishing the cubical, dodechahedral and octahedral faces of diamond and suggested an explanation of these variations in terms of its crystal structure.

## PROF. BLACKETT AT BANGALORE

IN an interesting lecture on the Magnetism of Rotating Bodies delivered before the Physics Section of the Indian Institute of Science on the 24th August 1948, Prof. P. M. S. Blackett, F.R.S., the distinguished British scientist now on a visit to India, reviewed the latest position of the general theory proposed by him last year in regard to the magnetic field of massive rotating bodies.*

Introducing the subject, Prof. Blackett stated how for a long time it has been known, especially from the work of Schuster, Sutherland and H. A. Wilson, that the magnetic moment $P$ and the angular momentum $U$ of the earth and the sun are nearly proportional and that the constant of proportionality is nearly the square root of the gravitational constant $G$, divided by the velocity of light $c$. He said that when, for the first time, the magnetic field of a star, *78 virginis*, was measured by Babcock, the calculated value of its magnetic field agreed with its observed value, leading to a verification of the above relationship for the three bodies and covering a range of $P$ and $U$ of more than $10^{10}:1$, though only 2,000 : 1 in measured field. It was therefore considered that the above relationship pointed to some new and fundamental property of rotating matter.

Proceeding, the distinguished lecturer surveyed the various specific theories of earth's magnetism and remarked how recent investigations of Bullard and others favoured only the core theory. Their measurements of the earth's magnetic field down a mine 4,000 feet deep revealed an increase, though slight, in agreement with the core theory. But the magnitude of the increase was considered too small (though greater than marginal errors) to warrant any major conclusions. In this connection Prof. Blackett suggested that the problem of the earth's magnetism was of perennial interest and that it was "quite a serious proposition" for some one in India to carry out similar measurements in the Kolar Gold Fields, which he said, was the world's deepest mine, being nearly 9,000 feet deep.

In the course of his lecture, Prof. Blackett dealt also with the various factors such as the variability of the sun's magnetic field and others, that seemed to throw into doubt the fundamental nature of the relationship instituted by him between magnetic moment and angular momentum of rotating bodies.

*Vide *Nature*, 1947, **159**, 659.

# MANGANESE TOXICITY AS A PROBABLE CAUSE OF THE *BAND* DISEASE OF ARECA PALM

J. A. DAJI
(College of Agricultre, Poona.)

THE areca palms in the Ratnagiri and Kolaba districts of Bombay Province have been known for a long time to suffer from a disease locally known as *band*. The disease is characterised by the shortening and thickening of the leaves and leaflets which acquire a dark green colour and a leathery feel. The internodes become short as the palm advances in age and the stem gets constricted at the top. The palm stops bearing, the crown gets smaller and smaller and it ultimately dries up and falls off. The problem was investigated on several occasions during the last 50 years as a result of which it was found that no fungus or insect was responsible for causing the disease and that it was probably due to nutritional disorder brought about by poor soil fertility. In this note is presented an account of preliminary investigations carried out in 1944 on the soils of some of these gardens.

The soil consists of a sandy coastal alluvium derived from trap and laterite, and contains considerable quantities of magnetic oxide of iron which, at some places, was found to be present in the form of regular bands about 4 to 6 inches in thickness. The morphological examination of the profiles revealed the presence of free water in the lower layers. There was a complete absence of carbonates upto a depth of about three feet. At this depth a hard compact layer of sand mixed with lime was found to be present which seemed to act as a barrier to the free percolation of water.

The examination of soil samples collected from the vicinity of diseased and healthy trees in the gardens selected for this study showed that they were well supplied with nitrogen, phosphoric acid and potash. The soils near the diseased tree showed less available phosphoric acid and potash than those near healthy trees. They were on the whole poor in lime ($CaCO_3$) and in many layers it was absent altogether. They did not show any excessive accumulation of soluble salts. The ammonifying and nitrifying powers as well as the respiratory activity of the soils were found to be considerably impaired, more so near the diseased tree. The soil reaction varied from neutral to slightly alkaline.

While determining the pH value by the quinhydrone method some of the samples showed a considerable drift in the potential. The presence of manganese oxides was, therefore, suspected. The soils were, therefore, analysed for total, water soluble, exchangeable and easily reducible manganese.[1] Samples collected at two other localities, one at Sirsi and the other at Kirkee where this disease is absent, were also analysed for the various forms of manganese. The results (Table I) show that the soils from the affected area contain much more manganese, total as well as available, than those of the other two places. They are also very high in exchangeable and reducible manganese. The more striking feature is the presence of large quantities of available manganese in soil near diseased tree as compared to that near the healthy tree. The whole of the manganese in the surface layer near the diseased tree is present in an available form. The presence of such large quantities of available manganese seems to be due to the prevalence of reducing conditions in the profile brought about by partial waterlogging to which these soils are prone, and to the absence of free calcium carbonate in the soil.

TABLE I

*Total and available manganese in soil*
(Mgm. Mn per 100 gm. of air-dry soil)

| Description | Layer | Total | Water soluble | Exchangeable | Reducible | Total available |
|---|---|---|---|---|---|---|
| Profile No. I at Murdi in a diseased garden; near a healthy tree | 0–4" | 211·9 | nil | 98·2 | 16·0 | 114·2 |
| | 4"–18" | 229·5 | ,, | 32·9 | 101·2 | 134·1 |
| Profile No. III at Murdi in a diseased garden; near a diseased tree | 0–9" | 203·9 | ,, | 125·9 | 78·8 | 204·7 |
| | 9"–19" | 223·9 | ,, | 41·9 | 114·0 | 155·9 |
| | 19"–31" | 232·5 | ,, | 39·5 | 87·2 | 126·7 |
| | 31"–40" | 204·7 | ,, | 31·5 | 86·6 | 118·1 |
| Soil near a healthy tree in Ganeshkhind Fruit Experimental Station, Kirkee | 0–9" | 107·3 | ,, | 43·5 | 18·3 | 61·8 |
| | 9"–18" | 113·7 | ,, | 36·9 | 26·4 | 63·3 |
| Soil near a healthy tree at Sirsi, N. Kanara | 0"–6" | 91·5 | not determined | 39·0 | 40·5 | 79·5 |
| | 6"–12" | 55·5 | ,, | 26·5 | 20·9 | 47·4 |
| | 12"–18" | 75·6 | ,, | 23·7 | 31·0 | 54·7 |
| | 18"–24" | 98·1 | ,, | 25·2 | 53·6 | 78·8 |
| | 24"–33" | 69·6 | ,, | 29·1 | 30·5 | 59·6 |

TABLE II

*Manganese and iron content of the leaves of areca palm*
(Mgm. per 100 gm. dry matter)

| Description | | Manganese (Mn) | Iron (Fe) |
|---|---|---|---|
| Diseased garden at Murdi village | Healthy tree | 3·22 | 44·41 |
| | Tree just affected | 7·94 | 50·75 |
| | Diseased tree | 10·42 | 125·30 |
| Diseased garden at Anjaria village | Healthy tree | 8·11 | 64·71 |
| | Diseased tree | 17·88 | 222·60 |
| Healthy gardens | Healthy tree at Kirkee | 0·55 | .. |
| | Healthy tree at Sirsi | 3·67 | .. |

In order to see how the high availability of manganese in the soil affects its uptake by the plant, samples of the first leaf of the areca palm collected at all the three localities were

analysed for their total manganese contents. In addition to manganese they were also analysed for their iron contents. The results of this analysis given in Table II show that the leaves of the areca palm in diseased gardens contain much more manganese and iron than those in healthy gardens at both Kirkee and Sirsi where this disease is absen . Similarly even in diseased gardens the leaves of the tree affected with *band* contain much more manganese and iron than those of healthy trees. The high manganese and iron contents of the leaves in diseased gardens seem to be brought about by the high availability of these two constituents in the soils of this tract. The abnormally high absorption of these elements is likely to prove toxic and the toxicity so produced seems to be the cause of the disease.

It is intended to carry on further work to confirm these views when the work under a scheme of investigation submitted to the Indian Central Coconut Committee is started.

The author is indebted to Mr. M. M. Kibe for carrying out the analysis.

1. Piper, C. S., "The availability of manganese in the soil.," *J. Agric. Sci.*, 1931, **21**, 762.

# THE OCCURRENCE AND UTILIZATION OF LIGNITES

C. KARUNAKARAN, M. NARASINGA RAO AND R. SUBBIAH
(*Andhra University, Waltair*)

## Occurrence

LIGNITE is immature coal or partially carbonised fossil wood, brown or black in colour, amorphous or having a conchoidal or cubical fracture and generally retaining its woody fibre. It is intermediate in its qualities between peat and coal. It occurs in large deposits in various parts of the world, chiefly in Australia, Canada and Central Europe. In India, its occurrence is reported from several localities mostly from tertiary deposits[1]; the Kashmir Valley formation,[2] in Pondicherry,[3] in Palana (Bikaner), Jurassic strata of Cutch and in Mianwali Dist. (Kalabagh) in N.W.F.P., in Ganges delta. In South India lignites in Malabar and Travancore[4] are of importance; the areas mentioned therein are Warkalai in Travancore, Beypore in S. Malabar and between Palghat and Calicut.

During the course of investigation in N. Malabar, beds of lignite were found at several places in Cannanore, an account of which does not appear to have published till now. The lignite in this place is seen at the cliff faces overlooking the sea and is overlain by hard laterite the latter having a thickness of about twenty feet. The base of laterite above the lignite beds is clearly marked by a hard pan about an inch thick. The lignite occurs as two beds separated by bluish clay and partly intermixed with it. The upper bed is about a foot thick and the lower about five feet in thickness. Numerous lumps and 'twigs' of marcasite are found in these beds probably formed as pseudomorphs after the woody matter. The outcrop is traceable along the coast for a distance of about half a mile and inland wells penetrating beneath the laterite shows the lignite and blue clay and finally the archæan gneiss. The lignite is brown in colour and has a strong smell of sulphur. Here and there, lumps of fossil gum are found. The woody structure is visible on breaking the lignite.

| Per cent. | Present sample | Place cliff | Chilakur cliff | | Vettur cliff |
|---|---|---|---|---|---|
| | | | (i) | (ii) | |
| Moisture .. | 18·84 | 13·5 | 16·49 | 11·18 | 11·51 |
| Vol. mat. .. | 35·5 | 28·35 | 38·24 | 23·57 | 21·28 |
| Fix. carbon | 34·3 | 21·4 | 40·83 | 10·75 | 6·77 |
| Ash .. | 11·36 | 36·7 | 4·43 | 54·5 | 60·4 |
| Sulphur .. | 2·88 | .. | .. | .. | .. |
| Water sol. | 5·2 | .. | .. | .. | .. |
| Lignin .. | 6·1 | .. | .. | .. | .. |

## Analysis

The analysis of the sample is given in the above table along with those of others from different sources.

On extraction with chlorofo:n unler slight pressure the present sample of lignite yielded about 2% of yellow, brittle, non-stuky wase which had the following characteristics:

| Solvent | % Wase. | M. P. ° C. | Sap. V. | Iod. V. | Ref. |
|---|---|---|---|---|---|
| Benzine .. | .. | 78·9 | 60–105 | 10–20 | (5) |
| Chloroform | 2 | 81·85 | 120·0 | 69·9 | Present sample |

## Utilization

The value of lignite as a fuel is low. Various methods, such as briquetting, low temperature carbonization, gasification to produce water gas and producer gas and hydrogenation under high pressures and temperatures to convert to hydrocarbons have been suggested and worked to improve its fuel value. Technical methods of preparing charcoal from it have been recorded.

A preliminary experiment carried out to produce active charcoal from the present sample is reported here. After extraction of the wax, it is dipped in zinc chloride solution, dried and heated in a tubular furnace in the absence of air at about 700-80.° C. 26% Distillate—tar containing 12% phenol and 52% residual of carbon are obtained. The carbon is cooled, treated with sulphuric acid, washed, dried and ground. The ground sample is found to be a good absorbent of color of jaggery solution. Further detailed investigation on the distillation of lignite under different conditions, especially at higher temperatures and in the presence of steam are under programme of work.

1. *Index to Records, G. S. I.*, T. H. D. La Touche, 1936, **1–65**, 338–39; *Memoirs*, **1–54**, T. H.D. La Touche, 1932, 201–202. 2. *Rec. G. S. I.*, 1924, **55**, 241. 3. Pitchamuthu, C. S., *Dept. of Industries Bulletin No.* **26** (*Travancore*). 4. *Rec. G.S.I.*, **16**, 9, 102; *Rec. G.S.I.*, **15**, 98, 99. 5. *Industrial Fats and Waxes*, by Hilditch, Y., **149**.

# LETTERS TO THE EDITOR



## ON PRIMES WITH MAXIMUM RECURRING PERIODS FOR THEIR RECIPROCALS

1. It is well known that the reciprocal of a prime number $q$, when expressed in decimals, has a pure recurring period of $p$ digits where $p$ is a factor of $(q-1)$. When $p=q-1$, the prime is said to be one with maximum period for its reciprocal. The first six such primes are given by Hardy and Wright[1] with the remark that very little is known about them. In 1945, I gave a necessary and sufficient set of conditions[2] for $q$ to be such a prime, *viz.*, that $10^{(q-1)/p} \pm 1 \pmod{q}$ for all prime factors $p$ of $(q-1)$ and reduced this set to a single condition in the particular case where $q$ is a prime of the form $1+2^{\alpha}3^{\beta}$. It is regrettable to note that in 1947 a false criterion was published by R. V. Iyer in the Bombay University Journal[3] which may, however be rectified thus: For $q=1+2^{\alpha}p$ where $p$ and $q$ are primes $q \pm 137$, $\alpha \leqslant 22$, necessary and sufficient condition for $1/q$ to have a maximum period is $10^{(q-1)/2} \equiv -1 \pmod{q}$. This follows from the fact that prime factors of $10^m-1$ (when $m \leqslant 21$) of the form $1+2^{\alpha}p$ are 3, 7, 23, 53, 137, p being a prime.[4] This single criterion suffices to show that 233, 263, 269, 383 and 389 are primes whose reciprocals have maximum recurring periods.

2. We now give a single necessary and sufficient condition applicable to all cases in the form of a theorem:

*If* $q=1+2^{\alpha_0}p_1^{\alpha_1}p_2^{\alpha_2}\ldots p_r^{\alpha_r}$, $P=p_1p_2p_3\ldots p_r$, $Q=(p_1-1)(p_2-1)\ldots(p_r-1)$ *and* $10^{(q-1)/2} \equiv t \pmod{q}$, *where* $q, p_1, p_2, \ldots p_r$ *are odd primes, then a necessary and sufficient condition for* q *to be a prime with a maximum recurring period for* $1/q$ *is that* t *satisfies a cyclotomic congruence equation of degree* Q *and order* 2P.

The proof of this is immediate from my criterion[2] if we remember that $t^{2P} \equiv 2 \pmod{q}$ but $t^f \not\equiv 1 \pmod{q}$ for any factor $f$ of 2P. For example; when $q = 2^{\alpha}\,3^{\beta}\,5^{r} + 1$ and $10^{(q-1)/30} \equiv t \pmod{q}$, $1/q$ will have a maximum recurring period or not according as $t$ satisfies or does not satisfy the cyclotomic congruence equation

$$x^8+x^7-x^5-x^4-x^3+x+1 \equiv 0 \pmod{q}.$$

For the prime 151, $10^5 \equiv 38 \pmod{151}$ but 38 does not satisfy the above congruence equation. In fact the period for 1/151 is 75. For the prime 61, $10^2 \equiv 39 \pmod{61}$ and 39 satisfies the congruence equation, and therefore 1/61 has a maximum recurring period of 60 digits. In fact, the recurring decimal for 1/61 is 01639344 262295081967213114754098360655737704918032 7868852459.

3. Lastly we note that $10^{(q-1)/2\alpha_0} \equiv 1 \pmod{q}$ is the necessary and sufficient condition for

the recurring period to be odd for $1/q$, while $10^{(q-1)/2\alpha} \equiv -1 \pmod q$, $(1 \leqslant \alpha \leqslant \alpha_0)$ is the necessary and sufficient condition for the period of $1/q$ to be even.

A. A. KRISHNASWAMI AYYANGAR.

Mysore,
*September* 3, 1948.

1. Hardy, G. H., and Wright, E. M., *An Introduction to the Theory of Numbers*, 2nd *Edition*, 1945, 114. 2. Krishnaswami Ayyangar, A. A., and Kaprekar, D. R., *Journal Bombay University*, 1945, **14**, part 3, 8. 3. Venkatachalam Iyer, R., *Journal Bombay University*, 1947, **15**, part 5, 9. 4. Rollett, A. P., *Math. Gazette*, 1937, **21**, 411.

## REPLACEMENT OF TEETH IN *GAVIALIS*

IN *Current Science* for April 1943 reasons were given for the belief that the teeth of *Gavialis gangeticus* were seldom lost and replaced and the presence of many damaged teeth in old crocodiles likewise suggests that replacement does not occur in old age.

It is contended that this point of view overlooks the presence of dental germs and takes note merely of the three macroscopic rows of teeth as seen in the dissected jaw of mature specimens, but the assumption of constant succession still requires experimental proof.

Professor L. Berner of Marseilles has directed my attention to the arresting of growth of the canines by gastration of the wild boar, *Sus serofa* L., and animals where the primary teeth are shed immediately after they erupt or are lost early in life, as in most Mammals.

It would appear that the existence of other rows of teeth than the three commonly noted in crocodiles and gavials has fostered the conception of constant succession and there is need for teeth to be marked in other specimens and kept to determine how long they function.

Britannia Buildings, F. G. CAWSTON.
Durban,
*August* 5, 1948.

1. Cawston, F. Gordon, *Current Science*, 1943, **12**, 114.

## PHOSPHATE FROM BAGASSE ASH

BAGASSE has been largely used as a fuel, but its ash is discarded. It contains phosphate in an unavailable form. The present investigation was undertaken to find out how the phosphate could be converted into an available form for use as a phosphatic manure.

The bagasse for this work was obtained from the Kolhapur Sugar Mills. 1 Kg. of it yielded 40 gm. of ash.

On chemical examination, the ash was found to contain nearly 1·6 per cent. phosphate (calculated as $P_2O_5$); calcium, magnesium, potassium, and aluminium and iron (the last two calculated together as oxides) being respectively, 3·38, 0·0021, 0·0031, and 0·008 per cent. The rest was silicious matter.

The phosphate content of ash treated with hot water under pressure, with alkalis, and with mineral acids were estimated.

Quantities of distilled water were added to known weights of the ash in different test tubes, and heated in an autoclave at 120° C. at 15 lbs. for half an hour. The filtrates from these gave no test for phosphate.

Known weights of the ash were also treated with mineral acids and with sodium carbonate. The phosphate content of the filtrates are given in the following table.

TABLE

| Wt. of ash gm. | Treated with | Treatment | Percentage of phosphate as $P_2O_5$ in filtrate |
|---|---|---|---|
| 1 | 2 c.c. $H_2SO_4$ con. | No heating. Only kept aside for 24 hours. | 1·60 |
| 1 | 3 ,, ,, | | 1·60 |
| 1 | 5 ,, ,, | | 1·60 |
| 1 | 5 ,, ,, | Heated on water bath for 1 hour | 1·60 |
| 25 | 50 c.c. HCl (1 : 1) | Refluxed for 2 hours | 1·60 |
| 5 | 5 gm. $Na_2CO_3$ in 100 c.c. water | Boiled for 15 minutes | 0·55 |
| 5 | 2 gm. solid $Na_2CO_3$ | Fused, and extracted with water | 1·59 |

The phosphate was estimated by precipitating it as ammonium phosphomolybdate. The precipitate, after filtering and washing, was treated with a known excess of an alkali solution, the excess of which was determined by back-titration with standard acid.

These experiments suggested the possibility of using bagasse along with firewood rich in potash as a mixed fuel in boiler furnaces so that the resultant ash may contain soluble phosphate, and hence serve as a valuable fertilizer.

Accordingly, 1 part of bagasse and 3 parts of *Justicica picta*, locally known as "adulsa" were burnt together and subjected to prolonged heating for about 4 hours in the laboratory.

The mixed ash extracted with hot water contained 0·343 per cent. phosphate, in the filtrate.

A possible setback in such a procedure would be the presence in firewood of minerals yielding interferring ions. Similarly, the heat obtained from the petrol gas in the present instance may not have been enough to bring about the necessary fusion. But these experiments have shown a possibility which may turn out to be of importance.

Chemistry Desartment,
Rajaram College, Kolhapur, J. W. AIRAN.
30th *May* 1948.

## NUCLEIC ACID AND BACTERICIDAL ACTION OF PENICILLIN

THE remarkable antibiotic properties of penicillin have caused attention being directed towards a study of its mode of action,[1-5] but hitherto, a correct explanation of its action is not available. The recent reports of Pandalai

TABLE I

*Effect of additions of nucleic acid to penicillin in nutrient broth*

(4·5 ml. nutrient broth made upto 5 ml. after additions of nucleic acid and penicillin were made ; pure crystalline penicillin G., dissolved in phosphate buffer pH 7·0 was added wherever indicated ; incubated for 24 hours after inoculation with a 1 mm. loopful of a 1/1000 dilution of a 24-hour old culture of *Staphylococcus aureus*—FDA Strain).

| Concentration of Nucleic acid | Penicillin in Oxford units per ml. of broth | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 0·05 | 0·1 | 0·2 | 0·3 | 0·5* | 0 | 0·05 | 0·1 | 0·2 | 0·3 | 0·5* |
| | Incubated at 24° C. | | | | | | Incubated at 37° C. | | | | | |
| *Control—No Nucleic acid* | ++++ | – | – | – | – | – | ++++ | – | – | – | – | – |
| *Nucleic acid—Free acid* | | | | | | | | | | | | |
| 1/10,000 .. | ++++ | – | – | – | – | – | ++++ | ± | – | – | – | = |
| 1/5,000 .. | ++++ | – | = | – | – | – | ++++ | ± | – | – | – | – |
| 1/2,000 .. | ++++ | – | – | – | – | – | ++++ | + | – | – | – | – |
| 1/1,000 .. | ++++ | ± | – | – | – | – | ++++ | + | – | – | – | – |
| 1/500 .. | ++++ | ± | – | – | – | – | ++++ | ++ | – | – | – | – |
| 1/200 .. | ++++ | ± | – | – | – | – | ++++ | ++ | – | – | – | – |
| *Nucleic acid—Sodium Salt* | | | | | | | | | | | | |
| 1/10,000 .. | ++++ | – | – | – | – | – | ++++ | – | – | – | – | – |
| 1/5,000 .. | ++++ | – | – | – | – | – | ++++ | – | – | – | – | – |
| 1/2,000 .. | ++++ | – | – | – | – | – | ++++ | – | – | – | – | – |
| 1/1,000 .. | ++++ | – | – | – | – | – | ++++ | – | – | – | – | – |
| 1/500 .. | ++++ | – | – | – | – | – | ++++ | – | – | – | – | – |
| 1/200 .. | ++++ | – | – | – | – | – | ++++ | – | – | – | – | – |

* Experiments with concentrations of penicillin up to 16 units per ml. have been carried out and the results were just the same as when only 0·5 unit of penicillin per ml. was added.

and George[6,7] that nucleic acid in small concentrations causes an antagonistic action against penicillin is of special interest in this connection and merits careful re-investigation.

We have, therefore, studied the effect of additions of yeast nucleic acid (B.D.H. pure sodium salt and Merck's pure nucleic acid) in concentrations varying from 1/10,000 to 1/200 to broth containing penicillin at concentrations varying between 0·05 and 16 Oxford units per millilitre.

The results of these experiments are summarised in Table I.

It will be seen from these results that, when nucleic acid was used as the free acid and in concentrations at and above 1/2000, there was a small growth in tubes in which penicillin was added in concenfrations of 0·05 O.U./ ml. but not when higher concentrations of penicillin were present. The presence of nucleic acid—free acid or the sodium salt-did not affect the bactericidal action of penicillin when the antibiotic was present in concentrations greater than 0·05 O.U./ ml.

The absence of appreciable growth in similar tubes incubated simultaneously at 24° C. indicated the possibility that in the presence of nucleic acid, penicillin in very small concentrations is probably destroyed—more so at 37°C.—and hence the antagonistic effect of nucleic acid on penicillin as reported by Pandalai and George.[6,7] This is explained by the fact that nucleic acid (free acid) in solution has a pH of 4·0-4·4 and when added to broth at pH 7·0, brings down the pH to as low as 5·2-5·5 and at this pH and when incubated at 37° C. small concentrations of penicillin are fairly easily destroyed.[8] This, however, is not the case when nucleic acid is added after neutralization to pH 7·0 with alkali or when it is dissolved in phosphate buffer at pH 7·0. Thus, it is clear that nucleic acid does not reverse the bacteriostatic action of penicillin as reported by Pandalai and George.[6,7]

We wish to express our thanks to Major-General Sir S. S. Sokhey, Director, for his kind interest in the work.

Haffkine Institute,
Parel, Bombay,
*August* 30, 1948.

K. GANAPATHI.
V. SADASIVAN.
F. D. BHARUCHA.
M. R. RADHAKRISHNAN.

1. Hobby, G. L., Meyer, K., and Chaffee, E., *Proc. Soc. Exptl. Biol. and Med.*, 1942, **50**, 281. 2. Smith, L. D., and Hay, T., *J. Frankl. Inst.*, 1942, **233**, 508. 3. Lew, S. W., Foley, E. J., and Epstein, J. A., *J. Bact.*, 1944, **48**, 393. 4. Rantz, L. A., and Kirby, W. M. M., *J. Immunol.*, 1944, **48**, 335. 5. Miller, C. P., and Foster, A. Z., *Proc. Soc. Exptl Biol. and Med.*, 1944, **56**, 205. 6. Pandalai, K. M., and George, M., *Curr. Sci.*, 1947, **10**, 312. 7. —, *Brit. Med. J.*, 1947, **2**, 210. 8. Benedict R. G., Schmidt, W. H., Coghill, R. D., and Oleson, A. P., *J. Bact.*, 1945, **49**, 85.

## ACTION OF DIAZOMETHANE ON TRIACETYLGALLOYL CHLORIDE

IN the course of our attempts to synthesize 5-hydroxyadrenaline it was found necessary to prepare $\omega$-chloro-3,4,5-triacetoxy acetophenone (I).

$$3,4,5\ (CH_3COO)_3C_6H_2-CO-CH_2Cl \qquad (I)$$

$$3,4,5\ (CH_3COO)_3C_6H_2-CO\cdot CHN_2 \qquad (II)$$

Nierenstein and co-workers[1,2] have shown that $\omega$-halogenated acetophenones are formed by the action of diazomethane on aromatic acid chlorides. But our attempts to prepare (I) by the application of Nierenstein's reaction always yielded only the corresponding diazoketone (II) in good yield. A search in the literature revealed that Robinson and his collaborators had prepared (II) by the action of diazomethane on triacetylgalloylchloride and that the Robinson school[4,5] had differed in their views from those expressed by Nierenstein with regard to the mechanism of reaction between aromatic acid chlorides and diazomethane. Comparing his reaction with Schlotterbeck reaction[6], Nierenstein[1,2], explained the formation of the chloroketone as follows:

$$\begin{array}{l} R-\underset{\displaystyle Cl}{\underset{|}{C}}=O \ + CH_2N_2 \rightarrow R-\underset{\underset{\displaystyle Cl}{|}}{\underset{\displaystyle CH_2}{\underset{|}{C}}}=O \ + N_2 \end{array}$$

On the other hand, Robinson and his collaborators (*loc. cit.*) who obtained diazoketone as the major product, explained the reaction mechanism as follows:

$$R-CO\cdot Cl+CH_2N_2 \rightarrow R-CO\cdot CHN_2+HCl \qquad (A)$$

$$CH_2N_2+HCl \rightarrow CH_3Cl+N_2 \qquad (B)$$

$$R-CO\cdot CHN_2+HCl \rightarrow R-COCH_2Cl+N_2 \qquad (C)$$

But, unlike Nierenstein, Robinson and co-workers *had added the acylchloride (1 mol.) to the diazomethane solution* (2 *mols.*) whereby the tendency for the non-formation of the chloroketone might be dominant. A systematic study of the action of diazomethane on triacetyl galloyl-chloride has now been undertaken following Nierenstein's procedure.

In general, the experimental procedure was, *to add the diazomethane solution dropwise to the acid chloride* and not the sacid chloride to the diazomethane solution as in Robinson's procedure, with good stirring. The diazoketone separated out at the end of the reaction and was purified by crystallisation from alcohol. Experiments were conducted with varying proportions of diazomethane and triacetyl galloylchloride at 0°C. and at 23-26°C. But the product obtained was invariably the diazoketone (M.P. 125-126°C.) which on treatment with alcoholic hydrogenchloride or hydrogenbromide, gave the desired chloro-or the bromoketone respectively.

It was also found that triacetylgalloyl chloride could be prepared in a more facile manner by the action of thionyl chloride than by the action of phosphorus pentachloride[7] on triacetylgallic acid. The present work supports Robinson's explanation for the mechanism of the Nierenstein reaction.

The results of some typical experiments are tabulated in the table.

TABLE

| No. | Triacetyl galloyl chloride g. | Diazomethane in Ether g. | Temperature of reaction °C. | Experimental details | Yield of $\omega$-diazo-3, 4, 5-triacetoxy acetophenone (II) |
|---|---|---|---|---|---|
| 1 | 3 (1 mol.) in ether | 0·48 (1·2 mol.) | 23–6 | Kept overnight after the addition | 1·4 g. (46%) |
| 2 | 50 (1 mol.) in benzene | 10 (1·5 mol.) | 23–6 | Kept overnight | 13·5 g. (27%) |
| 3 | 5 (1 mol.) in chloroform | 1·5 (2·3 mol.) | 0 | 50 c.c. of the etherial solution of diazomethane added at °C. and 30 c.c. of it added at the ordinary temp. all at once | 5 g. (Theoretical) |
| 4 | 15 (1 mol.) in chloroform | 2 (1 mol.) | 23–6 | Diazomethane solution added with mechanical stirring | 8 g. (53%) |

Organic Chemistry Laboratories, Indian Institute of Science, Bangalore,
*April* 1, 1948.

M. V. BHATT.
B. H. IYER.
P. C. GUHA.

1. Clibbens and Nierenstein, *J. C. S.*, 1915, **107**, 1491–1494. 2. Malkin and Nierenstein, *J. Am. C. S.*, 1930, **52**, 1504–8. 3. Bradley, Robinson and Schwarzenbach., *J. C. S.*, 1930 **1**, 797. 4. Bradley and Robinson., *J. C. S.*, 1928, **1**, 1310–18. 5. —, *J. Amer. Chem. Soc.*, 1930, **52**, 1558–65. 6. Schlotterbeck, *Ber.*, 1907, **40**, 479; 1909, **42**, 2559. 7. Fischer, Bergmann and Lipschitz, *Ber.*, 1918, **51**, 55.

## WATER-MELON AND FOOD-POISONING

### 2. The Viability of the Test Bacteria in the Juice

BACTERIA of the food-poisoning group have been reported to proliferate[1] in the water-melon juice at a more rapid rate than the other tested intestinal bacteria; this may account for the outbreaks of food-poisoning through this source. Experiments on the viability of these bacteria in the juice, as the following results will reveal, substantiate fully the above observation.

For the experimental purposes the juice was collected in 10 *ml* quantities in sterile test tubes and was tested for sterility before use. Likewise, the initial pH of the juice was also

determined electrometrically. Duplicate sets of the tubes were then seeded with 0·1 *ml* saline-suspensions of the test bacteria, *viz.*, *E. typhosa*, *S. paratyphi*, *S. schottmuelleri*, *S. enteritidis* and *E. coli communis*, all the strains being the type cultures referred to previously.[1] Control tubes (uninoculated) were also maintained in every experiment. All the tubes were then incubated at the room temperature (30-31° C.) after 2-*mm* loopful from each tube was removed for inoculation on the MacConkey's agar slope. After 24-hrs. a loopful from each tube was again utilized for viability test on the same medium and another loopful was used for the inoculation of meat-infusion broth tube for securing more sensitive results. Further 1 *ml* aliquots removed aseptically from every tube was plated out with 9 *ml* of MacConkey's agar for confirmatory results. All the media so inoculated were incubated at 37° C. and the results read after 24 and 48 hours. In a similar way the viability tests were carried out after 48, 72, 96 and 120 hours of incubation of the juice samples at the room temperature.

From the duplicate sets of the seeded juice samples, one set was boiled for 10 minutes after 24-hrs. of incubation and the pH of the juice in every tube was determined. These readings indicated the changes produced in the initial pH of the juice as a result of the 24-hr. metabolic activities of the different bacteria. The other set (employed for the viability tests) together with the control tubes were subjected to heating and pH determination only after 120 hours, *i.e.*, after the test bacteria had completely disappeared from the juice. Altogether five different samples of the juice were examined in this manner. Since the initial pH and the results obtained in two of the cases overlap each other, the details of only four experiments are tabulated below.

| Expt. | Species | pH | | | Viability in hrs. |
|---|---|---|---|---|---|
| | | Initial | 24 hrs. | Critical | |
| 1 | T | 5·56 | 4·49 | 4·00 | 48 |
| | A | ,, | 4·44 | 3·86 | 48 |
| | B | ,, | 4·78 | 3·98 | 120 |
| | E | ,, | 4·66 | 3·93 | 48 |
| | C | ,, | 4·36 | 3·86 | 72 |
| | Control | ,, | 5·56 | (5·55)* | .. |
| 2 | T | 5·59 | 4·55 | 4·00 | 48 |
| | A | ,, | 4·52 | 3·92 | 48 |
| | B | ,, | 4·68 | 3·85 | 120 |
| | E | ,, | 4·68 | 3·92 | 48 |
| | C | ,, | 4·95 | 4·01 | 72 |
| | Control | ,, | 5·59 | (5·58)* | .. |
| 3 | T | 5·88 | 4·59 | 4·10 | 48 |
| | A | ,, | 4·48 | 3·86 | 48 |
| | B | ,, | 4·73 | 3·81 | 96 |
| | E | ,, | 4·66 | 3·85 | 48 |
| | C | ,, | 4·92 | 3·85 | 72 |
| | Control | ,, | 5·88 | (5·87)* | .. |
| 4 | T | 6·10 | 4·61 | 4·12 | 48 |
| | A | ,, | 4·51 | 3·98 | 48 |
| | B | ,, | 4·71 | 3·87 | 120 |
| | E | ,, | 4·69 | 3·97 | 48 |
| | C | ,, | 4·99 | 3·99 | 72 |
| | Control | ,, | 6·10 | (6·10)* | .. |

*Legend*: T = *E. typhosa*; A = *S. paratyphi*; B = *S. schottmuelleri*; E = *S. enteritidis*; C = *E. coli*, ( )* = Final pH.

The results indicate clearly that the death of the organism, in every instance, is attributable to a fall in pH, which is in agreement with that of Mackenzie[4], and it is interesting to note here that this fall in pH is more gradually registered in the case of *S. schottmuelleri*, *S. enteritidis* and *E. coli* as compared to the other two species; but still we find that the critical pH, which actually is responsible for the disappearance of the cells, is sooner reached in the *Eberthella* and two of the *Salmonella* species rather than in *S. schottmuelleri* and *E. coli*. *S. schottmuelleri* thus appears to be the more tolerant of the species in the genus and this is in agreement with the observation made before[2] in connection with sugarcane juice. Moreover the higher incidence of this species in the intestinal disturbances[3] in this part of the country, together with the observation that this organism can not only multiply at a very rapid rate in the water-melon juice but also retain all its cultural and antigenic characteristics, strongly suggest its possible aossociation with the outbreaks of food-poisonings.

Microbiology Department,
St. Xavier's College,
Bombay,
J. V. Bhat.
Madhu Raghunath.
*August* 9, 1948.

1. Bhat, J. V., and Raghunath, M., *Curr. Sci.*, 1948, **17**, 213. 2. Bhat, J V., and Reporter, R. N., *Ibid.*, 1948. **17**, 183. 3. Fernandes F., Unpublished data. 4. Mackenzie, D., *Lancet*, 1930, **219**, 789.

## A MOSAIC DISEASE OF *CARICA PAPAYA* L. IN THE BOMBAY PROVINCE

A mosaic disease of *Carica papaya* first collected in March 1947 at Bombay was later observed in June 1947 in a nursery at Poona, where majority of the papaya plants growing at the time were seriously diseased. Typical mosaic symptoms in the diseased plants suggested the possibility of a virus being involved. This was confirmed on transmission of the disease by sap inoculation to healthy papaya seedlings raised from seed in the insect-proof glasshouse. The serious nature of the disease and the rapidity with which it was spreading to the neighbouring papaya plantations warranted its immediate investigation. This note deals briefly with the symptoms, the virus, its transmission in nature and the possible line of control.

Under insect-proof conditions in the glasshouses at Poona, papaya plants invariably showed the first symptoms of disease in the form of solid dot-like necrotic spots all over the lamina of the new developing leaf in about 20 days following inoculation. Use of 600-mesh fine carborundum powder as an abrasive gave a higher percentage of infection and the disease symptoms also appeared a little earlier.

than in those plants which were inoculated without the use of the abrasive.

Leaves of a fully diseased plant develop well marked mosaic symptoms with blister-like patches of green tissue distributed indiscriminately all over the yellowish green lamina (Fig. 1). Leaf petiole is greatly reduced in size and the lamina, though reduced, is occasionally malformed. Conspicuous and elongated water-soaked areas are formed on the stem and petioles, while the top leaves assume an upright position due to which the diseased plants stand out from healthy ones in a garden.

FIG. 1. A leaf of a diseased *Carica papaya*, showing typial mosaic symptoms.

Fruits produced on diseased plants are few, elongated and smaller than those borne on healthy ones. Innumerable circular or concentric water-soaked lesions with a central solid spot appear all over the surface of fruits due to which they lose their market value.

The virus is quite unstable and appears to be of the non-persistent type. It loses infectivity after storage *in vitro* for 28 hours in the laboratory, withstands heating for 10 minutes at 53° C. but not at 55° C., and retains infectivity at a dilution of 1 in 1,000.

The virus is sap-transmissible, and is not carried in the seed. Out of 450 seeds from a diseased fruit sown, 340 germinated and produced only healthy seedlings. The disease has also been successfully transmitted by *Aphis gossypii* Glover collected from cotton and Brinjal, *A. malvae* Koch. collected from *Lagenaria vulgaris* Ser., *Aphis* sp. collected from *Euphorbia prolifera* and *Myzus persicae* Sulz. collected from *Brassica* sp. The banana aphis, *Pentalonia nigronervosa* Coq. and the white fly, *Bemisia tabaci* Genn., failed to transmit the disease. Although papaya plants in Poona are almost free from insects, yet it appears certain that the transmission of the disease in nature is accomplished by one or more of the four aphids which not only abound in large numbers in and around papaya plantations but are also air-borne.

Two virus readily infects *Carica papaya* varieties Washington Special, Honey Dew, Hawaiian, Ranchi, Ceylon, Bombay, Poona Long and Poona Round, *Lagenaria vulgaris* and *Cucumis sativus* L., but did not cause disease in *Nicotiana glutinosa*. In *L. vulgaris* and *C. sativus* symptoms of the disease appear as faint vein-clearing in patches accompanied with slight distortion of leaves. Typical mosaic symptoms are never exhibited.

Two distinct virus diseases of papaya have been reported so far. Cook[1] first described 'bunchy-top' of papaya from Porto Rico and later Ho and Li[2] observed it in the Kwangtung province, China. Oman[3] believed that bunchy-top was possibly transmitted by *Empoasca papayœ*. This was confirmed by Adsuar.[4] A similar type of disease transmitted by inarch grafting was reported from Coimbatore by Thomas and Krishnaswami.[5] Parris[6] observed a mosaic disease of papaya in Hawaii and found that it was transmitted by mechanical abrasion and inarch grafting but not by scion grafting.[7] Diseases of doubtful origin have also been recorded by Simmonds[8] and Baker.[9] The mosaic disease of papaya recorded in this note seems to be caused by a virus distinct from those reported so far.

The only line of control helpful in checking the further spread of the disease lies in thorough destruction of all diseased plants and this measure should be rigidly enforced in order to save papaya cultivation from complete extinction.

Further work on the host range and insect transmission is in progress.

Grateful acknowledgements are due to Dr. B. N. Uppal for helpful encouragement. This investigation is being carried out under a scheme financed by the Indian Council of Agricultural Research.

Department of Plant Pathology, S. P. CAPOOR.
College of Agriculture, P. M. VARMA.
Poona, 5,
*August* 7, 1948.

1. Cook, M. T., *Phytopath.*, 1931, **21**, 124. 2. Ho, W. T. H. and Li, L. Y., *Lingnan Sci. Jour.*, 1936, **15**, 67 *3. Oman, P. W., *Jour. Agric. Uni. Porto Rico*, 1937, **21**, 567. 4. Adsuar, J., *Sci.*, 1946, **103**, 316. 5. Thomas, K. M. and Krishnaswami, C. S., *Cur. Sci.*, 1939, **7**, 316. *6. Parris, G. K., *American Soc. Hort. Sci. Proc.*, 1939, **36**, 263. 7. Parris, G. K., *Hawaiian Agric. Exp. Sta. Bull.*, 1941, **87**, 43 8. Simmonds, J. H., *Queensland Agric. Jour.*, 1937, **48**, 544. 9. Baker, R. E. D., *Trop. Agric.* (*Trinidad*), 1939, **16**, 159.

* Original papers not seen.

## PHYTOPATHOLOGICAL EXAMINATION OF SEEDS BY ULSTER METHOD

SEEDS of four types of groundnut, four types of tobacco and two types of castor were received by me from the Economic Botanist (Oilseeds) to Government, U.P., for the issue of phytopathological certificates, as these seeds were

TABLE I

*Percentage of healthy seeds and of various fungi obtained from seeds of different types of groundnut, tobacco and Castor.*

| *Arachis Hypogea* Linn. (GROUNDNUT) | | | | | *Nicotiana Tabacum* Linn. (TOBACCO) | | | | | *Ricinus Communis* LINN. (CASTOR) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fungi | Type (T. 25) | Type (T. 4110) | Type (R2) | Type (T. 9) | Fungi | Type (Napani Surti) | Type (H.S. Chirala) | Type (I.P. 28) | Type (F.D. Local | Fungi | Type (T. 3) | Type (T. 12) |
| *Fusarium* Sp. | 25 | 20 | 10 | 97 | *Aspergillus niger* van Tieghem | 11 | 8 | 5 | 49 | *Cercosporina ricinella* (Sacc. & Berl.) Speg. | 26 | 29 |
| *Rhizoctonia solani* Kuhn | 30 | 5 | 2 | 1 | *Aspergillus* sp. | 4 | 2 | 0 | 7 | *Aspergillus niger* van Tieghem | 74 | 71 |
| *Cercospora personata* (B. & C.) Ellis | 25 | 25 | 10 | 0 | *Fusarium* sp. | 0 | 0 | 2 | 0 | Healthy seeds | 0 | 0 |
| *Aspergillus niger* van Tieghem | 10 | 50 | 75 | 2 | *Alternaria* sp. | 0 | 0 | 0 | 5 | | | |
| *Aspergillus* sp. | 10 | 0 | 3 | 0 | Sterile fungus | 2 | 0 | 0 | 9 | | | |
| Healthy seeds | 0 | 0 | 0 | 0 | Healthy seeds | 83 | 90 | 93 | 30 | | | |

to be exported to China as required by the Director of Agriculture, China. Randomized samples of 100 seeds from each type were examined after plating out ten seeds kept at an equal distance from each other in each plate containing 10 c.c. of 2 per cent. malt extract agar medium after incubating them for five days at the room temperature according to Ulster method as given by Muskett and Malone (1941). The data are given in Table I. The per centage of parasitic fungi in different types of groundnut, *viz.*, T. 25, T. 4110, R2 and T. 9 was 80, 50, 22 and 98. The per centage of healthy seeds in different types of tobacco, *viz.*, Napani Surti, H. S. Chirala, I.P. 28 and F. D. Local was 83, 90, 93 and 30. The percentage of parasitic fungi in castor, Type T. 3 was 26 and in Type 12 was 29.

Plant Pathology Section, U. B. SINGH.
Department of Agriculture,
United Provinces, Kanpur,
*July* 30, 1948.

1. Muskett, A. E., Malone, J. P., "The Ulster method for the examination of flax seed for the presence of seed-borne parasites," *The Annals of Applied Biology*, 1941, **28**, 8-13.

## DODDER OR LOVE VINE ON BERSEEM IN U.P.

THE dodders or love vines are of importance in foreign countries as pests of clover, alfalfa and flax. Some of the common names are "strangleweed", "goldthread", "hairweed", "pulldown", "hailweed", "devil's-hair", "devil's ringlet", "devil's-guts" and "hell-bind".

These belong to the single genus *Cuscuta*, of the *Cuscutaceæ*, a family very closely related to the *Convolualaceæ* or morning glory family. Perhaps the ancestral habit of the genus of twining around other plants for support lead to the permanent habit of parasitism. According to Yuncker (1932) there are 158 species of *Cuscuta* on a great variety of hosts. In the month of April 1948 the whole canal irrigated crop of berseem grown partly for fodder and partly for seed purposes at the Government Agricultural Farm, Haldwani (District Naini Tal), U.P., got severely affected by dodder, *Cuscuta arvensis* Bey. This is the first record of dodder *Cuscuta arvensis* Bey. on berseem (*Trifolium alexandrinum*) from the United Provinces. It may have been introduced into this farm through irrigation water or seed. The contaminatad seed is generally the first source of infections, but after that other means of spread, *viz.*, (i) by hay from infested field, (ii) contaminated manure and (iii) by farm operations and (iv) the movement of livestock. It is carried over from one season to another either by seed or by established stems on perennials.

*Control.*—At first it is necessary to pay full attention to practices to prevent introduction of dodder, and if present to guard against its spread by (1) the selection of dodder-free seed; (2) the avoidance of dodder infested berseem fodder; (3) preventing the movement of grazing animals from infested to clean fields; (4) restricting the flow of irrigation water so as to avoid passing through infested areas, (5) avoidance of the use of dodder-containing

manure, (6) destruction of the crop by burning before seeding and (7) by leaving the ground fallow after the selected eradication measures have been completed and then followed with a five-years rotation beginning with a non-leguminous tilled crop.

The seeds of *Cuscuta arvensis* Bey are much smaller in size than berseem seeds and these could be separated by means of suitable sieves. In U.S.A. the separation of dodder from commercial seeds is now generally done by seed companies provided with special cleaning machinery. Three types of cleaners are in use; (1) power driven graders with special screens, (2) the Dosser machine, in which the velvet linings retain the small dodder seed that cannot be screened out and (3) by an electro-magnetic process, in which the crop seed is mixed with iron powder. Much of the powder sticks to rough dodder seed which is then drawn out of the crop by magnets.

Plant Pathology Section, U. B. SINGH.
Department of Agriculture,
Kanpur, U. P.,
*July* 30, 1948.

Yuncker, T. G., *Mem. Torry Bot. Club*, 1932, **18**, 113-31.

## *XANTHOMONAS DESMODII-GANGETICII*, SP. NOV., UPPAL, PATEL AND MONIZ; A NEW BACTERIAL LEAF-SPOT OF *DESMODIUM GANGETICUM* DC.

THE disease appears as light yellow, watersoaked, round spots on the undersides of leaves of *D. gangeticum* found at Bassein in Thana District where it seems to be localised. It differs from other bacterial leaf-spots on legumes in its host range, morphological, cultural and bio-chemical reactions. The description of the pathogene causing this leaf-spot is as under:—

Short rods with rounded ends, single or in pairs but never in chains. Capsules present. Motile with a polar flagellum. Gram-negative. No spores and non-acid fast. Stains readily with gentian violet, carbol fuchsin and methylene blue. Colonies on potato dextrose agar are circular with entire margins, smooth, convex, glistening and butyrous. Odour is absent and colour of the medium remains unchanged. Colour of the colonies is empire yellow. Internal markings (striations) not coming upto the margin. Moderate cloudiness in nutrient broth with no floccules and pellicle. Colour remains unchanged and odour is absent. Optimum temperature for growth is 20°-25°C., minimum about 5°C. and maximum about 35°C. Thermal death point is between 50° and 52°C. The organism liquefies gelatin and has a strong diastatic action on starch. Casein is digested. Nitrates are not reduced and indole and ammonia are not produced. Hydrogen sulphide produced. Asparagin utilised as a sole source of carbon and nitrogen. Litmus reduced in litmus milk and plain milk is cleared. Utilises dextrose, sucrose, raffinose, galactose, maltose, xylose, lactose, arabinose, levulose, mannitol and salicin. Growth good in Uschinsky's solution; no growth in Cohn's and Koser's uric acid medium.

The organism is pathogenic to *Desmodium gangeticum* DC.

A detailed paper is being submitted separately for publication.

Plant Pathological Laboratory, M. K. PATEL.
College of Agriculture, L. MONIZ.
Poona,
*August* 20, 1948.

## PRELIMINARY OBSERVATIONS ON THE ROLE OF BLUE GREEN ALGÆ IN FISHERY PONDS AND IN THE CONTROL OF MOSQUITO BREEDING*

IT has now been realised that for tackling the urgent problem of increased fish supplies in the country, a rapid extension of fish culture through the utilisation of the neglected village ponds is one of the most hopeful ways. Public Health authorities interested in the control of mosquito breeding spray the same ponds with insecticides at frequent intervals and thereby make the ponds ineffective for fish culture. Thus there is great need at present for co-operative research with a view to integrating malaria control with fish culture.

In the course of a scheme of co-ordinating anti-malarial measures with pisciculture, Blue Green Algæ were found to play an important part.

It was observed that the fish culturists very often plant Blue Green Algæ [1,2] in nursery ponds in order to ensure a quick and healthy growth of carp fry. The utility of algæ as food for Indian Carps, has already been noted by Mookerjee[4] and Biswas[5]. The latter found that Blue Green Algæ "either epiphytic on the submerged water plants or floating freely as plankton serve as food to mosquito larvæ" while Senior White regards Blue Green Algæ as "inimical to *Anopheles* larvæ," (private communication). The observations recorded here will show that the growth of these algæ is inimical to the breeding of *Anopheles* larvæ.

Experiments have shown that Blue Green Algæ in a pond influences the pH of the water. The following table indicates the relative growth of Blue Green Algæ and the pH of water.

*Correlation between the relative growth of Blue Green Algæ and the pH of water.*

| pH | Cases of algal frequency | | | | |
|---|---|---|---|---|---|
| | Nil | Very thin | Thin | Thick | Total |
| 8·0 to 8·4 .. | 445 | 42 | 28 | 8 | 523 |
| 8·5 to 8·8 .. | 11 | 3 | 10 | 24 | 48 |
| Above 8·8 .. | 0 | 0 | 0 | 12 | 12 |

The particular species found in these tanks is *Mycrocystys aeruginosa* (Kutzing)‡

*pH value in relation to Mosquito Breeding*

Sen[3] has pointed out that *Anopheles sundaicus* does not breed in waters above pH 8·5, average pH suitable for its breeding being 8·2. If along with the manuring of waters, attempts could be made, either by the introduction of Blue Green Algæ, or by Chemical treatment, to keep the pH of the pond water between 8·5 and 8·8, healthy growth of fish could be ensured, and at the same time breeding of a *A. sundaicus* checked.

It appears that use of soap solution, while beneficial for the growth of fish, is inimical to *Anopheles*. This is also the experience of fish culturists in Bengal.

The other malaria vectors of Bengal, *A. philippinensis*, *A. culicifacies*, etc., do not breed in organically polluted waters. So, in scientifically maintained fishery ponds, they should have no chance of breeding.

Mr. S. Roy Chowdhury, Statistician to the Directorate of Fisheries, Bengal, has very kindly analysed the data given in the above table statistically and confirms the relationship between the growth of algæ and the pH.

After the above note was prepared for publication, a very interesting article by Fogg[6] on "Nitrogen fixation by Blue Green Algæ" (pp. 172-75, 1947) has come out wherein the ability of certain species of Blue Green Algæ for fixing atmospheric Nitrogen is pointed out, thereby contributing to the maintenance of the fertility of tropical soils and the productivity of fresh water. In Blue Green Algæ, nitrogen and carbon assimilation proceed side by side in the same cell. As Fogg puts it, "In combining the nitrogen-fixing and photosynthetic modes of nutrition, blue green algæ resemble the legume-nodule-bacteria system".

It would appear that by providing the optimum conditions for the growth of Blue Green Algæ, the assimilable nitrogen contents of the water could be increased to the benefit of fish culture and malaria-control. There is hence good scope for a useful line of research on this aspect which would be of interest both to pisciculturists and malarialogists.

Directorate of Fisheries, S. R. Das Gupta.
Bengal, Calcutta,
*August* 9, 1947.

1. Walch, E. W., Van Breeman, M. L., and Reyntjes, E. J., *Meded. Dienst. Volksgez. Ned-Ind.*, 1930, **19**, 400. 2. Hackett, L. W., Russell, P. F., Scharff, J. W., and Senior White, R., *Quart. Bull. Health Organisation of League of Nations*. 1937, 31. 3. Sen, P., *J. Mal. Inst. Ind.*. 1938, **1**, 259. 4. Mookerjee, H. K., *Cal. Review*, 1942, 228. 5. Biswas, K. P., *Science and Culture*, 1942, **8**, 189. 6. Fogg, G. E., *Endeavour.*, 1947, **6**, 172–75.

* Published with the kind permission of the Director of Fisheries, Bengal.

‡ My thanks are due to Miss Eva Mitra for identifying the species.

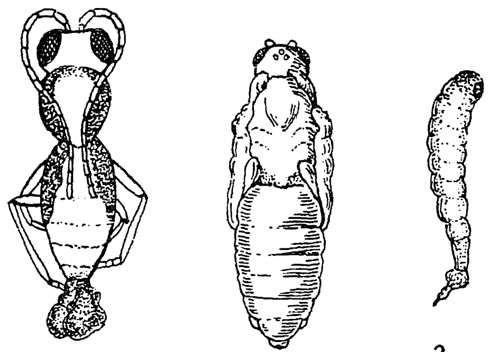
## STUDIES IN EXPERIMENTAL INSECT PARASITISM SUPERPARASITISM

*Bracon (Microbracon) gelechiæ* Ashm., is an ectoparasite of the larva of the potato tuber moth, *Gnorimoschema operculella* Zell., which has recently been imported into India from Canada, for the control of the potato tuber moth, a serious pest of potatoes in storage in India. This parasite is bred in large numbers on the larvæ of *Corcyra cephalonica* St., in the Parasite Laboratories of the Indian Agricultural Research Institute, New Delhi.

In the course of experimental studies on the host selection by *Bracon gelechiæ*, it was observed that superparasitism had a direct bearing on (1) the size of individuals bred, (2) the number of adults bred per host and (3) the sex ratio of the resulting offsprings. It was found that superparasitism as a result of overcrowding of adult parasites in the oviposition cages is one of the causes of the low rate of breeding of *B. gelechiæ*.

*Superparasitism and size and vigour of individuals*

In cases where more than one parasite grub shared a single host it was found that as the number of parasite grubs per host increased, the size of the individual parasites decreased and in certain cases, degenerate forms (Figs. 1, 2 & 3) appeared as a result of overcrowding



1 2 3

FIG. 1. Undeveloped 'Runt' × 15.
,, 2. Undeveloped naked pupa × 18.
,, 3. Degenarated prepupa × 15.

and consequent insufficiency of food. These degenerate forms on "runts" as described by Salt were very inactive, short lived, and in all cases, died before laying eggs. Structural deformities, such as modified antennal segments and reduced wings were very pronounced in many cases (Fig. 1). In certain cases, the parasitic grubs, instead of spinning cocoon, turned into naked pupa (Fig. 2) which did not develop into adults.

*Superparasitism and sex ratio*

It was also observed in the course of these studies that the number of parasite grubs sharing a single host for their development had a direct bearing on the sex ratio of the adults

that emerged. Table I gives the sex ratio of adults which emerged from parasite grubs in different intensities of superparasitism on the larva of *Corcyra cephalonica* and also the average duration of the developmental period under the different conditions.

TABLE I

| No. of parasite grubs per host | Adults bred | | Mean No. of days taken for emergence from egg to adult |
|---|---|---|---|
| | Percentage Males | Percentage Females | |
| 1 | 33·4 | 66·6 | 8·6 |
| 2 | 16·7 | 83·3 | 8·3 |
| 3 | 22·2 | 77·7 | 9·0 |
| 4 | 25·0 | 75·0 | 9·0 |
| 5 | 26·7 | 73·3 | 8·3 |
| 6 | 26·7 | 73·3 | 9·0 |
| 7 | 57·2 | 42·8 | 8·5 |
| 8 | 62·5 | 37·5 | 8·5 |
| 9 | 44·5 | 55·5 | 11·0 |
| 11 | 63·7 | 36·3 | 9·5 |
| 18 | 61·2 | 38·8 | 11·0 |
| 19 | 73·7 | 26·3 | 11·2 |
| 29 | 82·8 | 17·2 | 10·5 |

It can be seen from the above table that as the number of parasite grubs which share a single host increases, the number of males also increases, or in other words, when the food supply is sufficient more females are produced and this number decreases as the food supply becomes less and less. The intensity of superparasitism depends on the density of female parasites in the ovipositon cage. It may be also seen from the table that as the number of parasite grubs that shared a single host increased the developmental period was prolonged or the emergence of the adult parasites was delayed.

These findings are of considerable interest and also of practical importance in the propagation of insect parasites. Further work is in progress to find out the influence of different species of alternate hosts on the parasite, *B. gelechiæ*. Full details on these studies will be published elsewhere.

Division of Entomology, I.A.R.I., New Delhi, *June* 29, 1948.
E. S. NARAYANAN.
T. V. VENKATRAMAN.
G. C. SEN GUPTA.

1. Salt, *Proc. Roy. Ent. Soc.*, London (A), 1940, **15**, 81–95.

## *PELLICULARIA FILAMENTOSA* (PAT.) ROGERS, COMB. NOV. CAUSING A ROOT-ROT OF BERSEEM (*TRIFOLIUM ALEXANDRINUM* LINN.) IN THE UNITED PROVINCES

IN April 1948 the fungus *Pellicularia filamentosa* (Pat.) Rogers, formerly known as *Rhizoctonia solani* and *Corticium solani* was found causing a severe root-rot of berseem (*Trifolium alexandrinum*) in the United Provinces at the Government Agricultural Farm, Nawabganj (Bareilly). This is the first record of this fungus on berseem from the United Provinces.

In the first week of April 1948 the berseem crop suddenly began to die. The havoc was hastened by the easterly winds that blew during this period. Watering had only an adverse effect. The seed obtained from the fields where infection was severe remained shrivelled up due to the premature drying of the crop. In a number of plants the seeds did not form at all. In some fields the infection was only slight or took place when the seed was mature. The seed obtained from such fields was apparently healthy. The same disease was observed in berseem fields of cultivators situated at some distance from the farm. Usually plants 5″ to 12″ were affected by this disease. In the early stage of the disease the parts attacked are the roots and the crown, where a slight discolouration is produced which gradually deepens to black. By this time the leaves and branches of the plant begin to wither. In a later stage, the bark of the crown dries up. The tap root rots and the development of secondary roots is restricted. In advanced stages very small scattered dot-like structures are formed on and near the crown. These can be seen even by the naked eye. They are the sclerotia. It is through them that the disease is carried from year to year. They are known to remain viable in the soil from four to five years. Hence crop rotation is the only suitable means of controlling this soil borne disease.

I am very much grateful to Dr. U. B. Singh, M.SC., D.PHIL., ASSOC. I.A.R.I., Plant Pathologist to the Government, U. P., for his helpful suggestions and kind interest in going through the manuscript.

Section of the Entomologist, to Government, U.P., Kanpur, *July* 1, 1948.
D. N. GARG.

## UNIFORM GLAZED PANS FOR RAISING SUGARCANE SEEDLINGS

AT the Coimbatore Station, countrymade earthenware pots have been used all these years for germinating sugarcane seeds and raising seedlings. Dr. J. N. Mukherjee, Director, Indian Agricultural Research Institute, during his inspection visit of the Station in January 1946 remarked on the patchy character of the variations in the germination and vigour of seedlings and their markedly non-uniform stand in the same pot in which fluff from the same cross was used. The pots have the shape of a truncated conical pyramid with the narrower side resting on the floor. They are not of very uniform size and their bottom surface is uneven. Besides, the bamboo platform on which they rest also sags somewhat and the surface is uneven. All these features combined, in his opinion, to affect the seed-

lings differently in different parts of the pot and it was decided to try for comparison glazed pots of standard cylindrical shape made in the pottery furnaces. In the countrymade pots sometimes water accumulates in certain places and the finer particles sometimes gather in the lower portions as a result of watering. Many seedlings die off or become pale and look sick. The countrymade pots are, however, much cheaper, but this is partly offset by the greater durability of the glazed pots. The glazed pots have shown so striking a difference in the health and vigour of the seedlings that it is considered desirable to bring the difference to the notice of others.

Two different crosses were tried. The pans, as has been the usual practice in this Station, were filled with equal quantities of horsedung and sand in equal proportions and two grams of fluff was sown in each pan and care was taken to see that each pan received the same quantity of water. The pans were kept on level surface and germination counts recorded at intervals of five days till the 25th day. After the 60th day when the seedlings had established themselves, certain of the seedlings were noticed to have died possibly due to competition. The mortality rate was recorded on the 80th day.

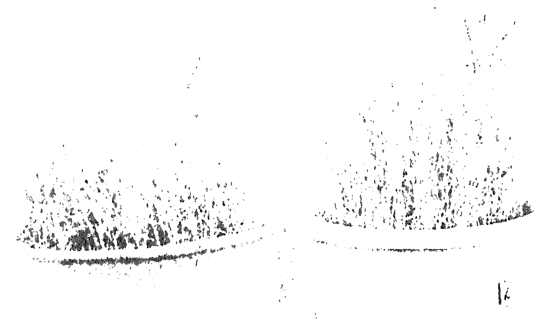


Plate I

Earthenware pan Glazed pan

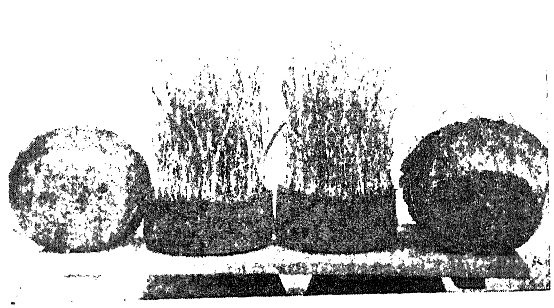


Plate II

Earthenware pan Glazed pans Earthenware pan

The germination percentage was found to be slightly higher in the glazed pans but is not significant. As regards mortality of the seedlings, the difference appears to be significant (5% level) in the batch of seedlings of the cross Co. 453 × Co. 557 and also if both the crosses are taken together. The main difference, as will be seen from the accompanying photograph (Plate I) was in the health, vigour and uniform growth and distribution of the seedlings. The seedlings in glazed pots are vigorous and uniform in growth and distribution and the seedlings at the periphery did not differ in growth from the rest of the pot while the seedlings in the usual pot were not uniform in stand and many of them showed yellowish leaves and the seedlings at the periphery were definitely poor in growth.

A peculiarity that will be noticed in the countrymade pots is that the roots come out of the soil on to the inner surface of the pot but not so in the glazed pots; evidently owing to the better aeration through the walls of the countrymade pots. The difference in the behaviour may partly be ascribed to greater loss of water through evaporation through the sides of the locally made pots and irregularity in shape. Also, the seedlings near the periphery of the locally made pots have a much lower thickness of the nutrient material available to them.

Sugarcane Breed. Station, Coimbatore,
*August* 17, 1948.
N. L. Dutt.
J. Thuljaram Rao.
T. A. Davis.

## A CHROMOSOME DEFICIENT PADDY TYPE

A strain of the cultivated paddy Muthusamba, which was segregating for barren sterile plants on a simple mendelian ratio, was reported previously[1] in this journal. The segregating form has been grown every year and probable reason for its genetic behaviour studied.

Cytological study of the root tips has given a clue to its causation. The stunted sterile segregants were found to have 22 chromosomes only, as opposed to 24, normal for paddy. This deficiency of two chromosomes is inferred to cause the changed growth as well as complete sterility. It can be seen that the absence of panicle formation can be caused only by a deep-seated cause like this, while lack of grain setting may be due to genetical or pathological causes. The chromosome counts were made carefully with different collections of root tips, done in plants grown in two seasons. Counts were made only in the clearest metaphase plates, and have been checked by independent observers. However, the pollen grains of heterozygous plants do not show dimorphism corresponding to the full and reduced chromosome complements. Confirmation of this explanation is being sought in the meotic stages in the heterozygote.

The inference is that originally, by nondisjunction in meiosis, a gamete with 11 chromosomes (a loss of one from the normal genom of 12.) was formed, and this on fertilisation gave rise to a normal looking plant with 23 chromosomes. This plant gave rise to 24 chromosomed; heterozygous 23 chromosomed; and

sterile 22 chromosomed plants, in 1 : 2 : 1 genotypic ratio, or 3 : 1 phenotypic ratio. The heterozygotes continue to segregate every year, and the further heterozygotes have been grown from them.

The sterile types can be maintained for a long time by vegetative propagation. The deficiency affects the cytological characters of the roots also, giving rise to clumped mitotic plates, and a large number of empty cells even in growing root tips. The interest of the form lies in use of the heterozygote for ultimately preparing a chromosome map of paddy. From general observation it looks as if such deficients do occur, though rarely, and can be secured by careful selection amongst the large amount of material handled at the Paddy Breeding Station. The collection of such types is being started.

The writers are indebted to the Paddy Specialist and his staff, for continuous help in this work.

Agricultural College and Research Institute, Coimbatore, S. SAMPATH.
V. KRISHNASWAMY.
*August* 13, 1948.

1. *Curr. Sci.*, 1934, **3**, 22.

## STUDIES IN ANTIMALARIALS

### N[1]- Aryl-N[5]-alkyl-biguanides

FOLLOWING the discovery of Paludrine[1] as a potent antimalarial, sufficient interest was developed in the field of substituted biguanide derivatives as potential antimalarials. The first attempt to improve upon the activity of the parent drug has been to replace its N[1]-p-chlorophenyl part with phenanthrene and quinoline radicals but all these compounds were found to be inactive when tested against experimental malaria.[2,4,3] The N[5]-isopropyl group of paludrine has been replaced with 5-and-8-quinolyl,[5,6] 2-thiazolyl;[7] *p*-phenyl arsonic acid,[8,10,11] *m*-phenylsulphonamide and *p*-phenyl sulphanomide (substituted or otherwise) groups and the last two have shown antimalarial activity when tested against avian malaria.[12]

Considering that a biguanide system is essential for activity in this type of antimalarials, in addition to the introduction of complex groups (as detailed above) it was thought worthwhile to study the simpler substituents at the either end of a biguanide link. Consequently various isomers and analogues of paludrine were prepared (*vide* table) where the effect of the chlorine atom in the different positions in the phenyl ring I-II, the effect of other halogen atoms and cyano group at the para position of the phenyl ring (IV-VII) and the effect of an extra chlorine atom in the p-chlorophenyl group (IX, X) have been studied. The work has been further extended in which the isopropyl group in N[1]-2:4-Dichlorophenyl-N[5]-isopropyl-biguauanide (X) has been replaced by a number of branched chain alkyl groups derived mostly from the different alkyl amines previously reported[14] (XI—XIX).

Table A. N[1]-Aryl-N[5]-alkyl-biguanides.

$$X.NH-\underset{\textstyle NH}{\overset{}{C}}-NH-\underset{\textstyle NH}{C}NH.R,\ HCl$$

| No. | X | R | m.p., °C. |
|---|---|---|---|
| I | *o*-Chlorophenyl | Isopropyl | 250 |
| II | *m*-Chlorophenyl | do | 227–228 |
| III | *p*-Chlorophenyl (paludrine) | do | 241 |
| IV | *p*-Flourophenyl | do | 226 |
| V | *p*-Bromophenyl | do | 237-38 |
| VI | *p*-Iodophenyl | do | 234 |
| VII | *p*-Cyanophenyl | do | 231–32 |
| VIII | β-Naphthyl | do | 229–30 |
| IX | 3 : 4 Dichlorophenyl | do | 236 |
| X | 2 : 4 Dichlorophenyl | do | 240 |
| XI | do | Methyl | 215 |
| XII | do | Dimethyl | 231 |
| XIII | do | 2-Butyl | 240 |
| XIV | do | 3-pentyl | 221–22 |
| XV | do | *iso*-Pentyl | 216–17 |
| XVI | do | β *iso* Hexyl | 217 |
| XVII | do | 2-Pentyl | 220–221 |
| XVIII | do | Piperidyl | 230–31 (Base 150) |
| XIX | do | 2-Octyl | 224 |

All these derivatives have been prepared by the interaction of the required arylcyanoguanidines[13] with the alkyl amines in presence of copper sulphate or with their hydrochlorides by fusion. All the biguanides were isolated as white crystalline hydrochlorides.

Full details will appear elsewhere.

Our thanks are due to Dr. B. H. Iyer for his keen and helpful interest in the work and to the Indian Research Fund Association for the award of a fellowship to one of us (H. L. Bami).

Organic Chemistry Laboratories, Indian Institute of Science, Bangalore, H. L. BAMI.
P. C. GUHA.
*September* 9, 1948.

1. Curd and Rose, *J. Chem. Soc.*, 1946, 729. 2. May, *J. Org. Chem.*, 1947, **12**, 437, 443. 3. Mosettig, *Ibid.*, 864. 4. May *et al.*, *ibid.*, 869. 5. Gupta, Iyer, and Guha, *Current Science*, 1948, **17**, 53. 6. Gupta and Guha, *ibid.*, 185. 7. Personal Communication. 8. Roy, Iyer and Guha, *Current Science.*, 1948, **17**, 126. 9. Bami, Iyer and Guha, *J. Indian Inst. Sci*, 1948, **30A**, 9. 10. *indem*, *ibid.*, 1947, **29A**, 16. 11. *indem.*, *ibid.*, 1948, **30A**, 1. 12. *indem.*, *Current Science.*, 1947, **16**, 386. 13. Bami, *J. Indian Inst. of Sci.*, 1948, **30A**, 16. 14. Bami, Iyer and Guha, *ibid.*, 1947, **29A**, 9.

## A NOTE ON THE OCCURRENCE OF THE PORCELLANITE STAGE OF THE SEMRI SERIES OF LOWER VINDHYAN IN JODHPUR STATE

In his "Geological Notes on Great Indian Desert between Sind and Rajputana"[1] Blanford, calls one of the formations met with in his traverse as 'Shales and boulder bed of Lowo and Pokran'[2] and described these beds as consisting of "green, red and variously coloured shales, occasionally soft, but often hard and porcellanic. Some are fine, others are coarse and sandy, and contains grains of pink felspar and of a green mineral resembling epidote; some beds being composed throughout of one or the other of these minerals. In places, pebbles and boulders of the Malani porphyries and syenite are found towards the base of the shales; the boulders being occasionally from three to four feet in diameter while remains of much larger blocks, which had fallen to pieces but which could not have measured less originally than twelve to fifteen feet in diameter, were seen at Lowo. These boulders appear to have been brought from a distance, and there is some reason for supposing that they may have been transported by ice, as the underlying surface of the Malani porphyry near Pokran was in one instance found to be grooved and striated."[3].

Last year I had occasion to visit Lowo and Pokran first independently and again in the company of Sir Cyril Fox.

At Pokran, the rocks observed were sharply cross-bedded soft red sandstone overlying rhyolite either directly or through the intervention of an impersistent bed of conglomerates composed almost entirely of prolate spheres of rhyolite upto a foot in diameter.

The soft sandstone continue for about three miles E. SE. of Pokran on the way to Lowo, when exposures of rhyolite come in. About 5 miles from Pokran, the geology changes and rocks of a different nature appear. Fine-grained and porcellanic, the rocks range from chocolate to green in colour and rest directly on the rhyolite. Their best development is round Lowo, about 7 miles E. SE of Pokran and west of the salt lake where they outcrop in greater variety.

Pink and green, some are hard, porcellanite shale; others gritty containing grains of pink felspar embedded in an isotropic green material, resembling the porcellanite. Intercalations of thin papery purple shale and of bands of Fuller's earth are also seen, the latter being used for white-washing. North of the road the ground is strewn with pebbles of jasper. Thin bedded, the beds have low rolling dips.

The boulders of "Syenite" mentioned by Blanford have rolled from the neighbouring many low knolls of pink Siwana granite occurring about a thousand feet west of the salt lake. As is well known the Jalor and Siwana granites are the concluding phase of the Malani volcanic period. Exposures of Siwana granite are seen as far west as Sankra (Long. 71° 35′ 4″: Lat. 26° 44·29″) in Jodhpur State.

Except that we were both unable to trace any boulder bed here Blandford's description of the rocks near Pokran fits those here exposed.

The above beds answer to the description of rocks from the Lower Vindhyan, particularly from the Porcellanite stage, of the Son valley as described by Vredenburg[4] and Auden[5] rather than to any Talchir Boulder bed to which they have tacitly been supposed to belong. Sir Cyril thus confirmed, my earlier identification of the beds as belonging to the Porcellanite stage of the Semri Series.

These rocks have since been compared with those of the Porcellanite stage, Chopan, Mirzapur District U.P. obtained through the courtesy of the Geological Survey of India and have been found to be identical.

Another occurrence of the Porcellanite stage is in the low hillocks SW of Baurli (Long. 72° 43′ 51″: Lat. 26°21′48″ about 20 miles W.N.W. of Jodhpur City.

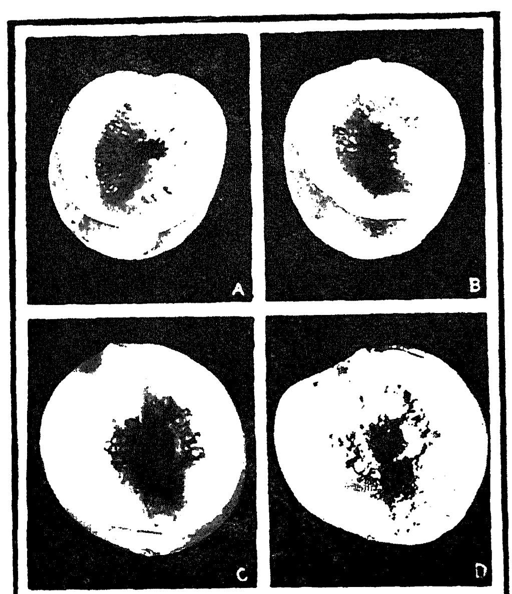
Dept. of Mines and Geology, Jodhpur, S. K. Borooah.
August 18, 1948.

1. *Records Geo. Survey India*, **10**, pt. 1. 2. *Supra* **17.** 3. *Supra* 17 4. *Memoirs G.S.I.*, **31**, pt. 1 94. 5. *Memoirs G.S.I.*, **42**, pt. 2, 153–157.

## INTERNAL BREAKDOWN OF GUAVA FRUIT (*PSIDIUM GUYAVA* L.)

Guava Fruits are known to suffer from very few diseases. Scrutiny of the available literature shows that there is only one disease reported from India[5] and three from abroad[1,3] and [4].

In the course of investigation of the wilt disease of guave tree[2], which is in progress in this laboratory, the author came across a guava fruit (Fig. 1 B) which was suffering



from a disease that has been termed internal breakdown. The particular fruit was quite fresh and healthy in its external appearance, and only when it was cut into two halves that the disease became apparent. Subsequently few more fruits were obtained from the Government Horticultural Gardens, Lucknow and Ghazipur orchard, Lucknow. A preliminary survey revealed that the disease was very rare.

In all the fruits, except two in which the disease had progressed considerably involving about 1/6th of the internal tissue (Fig. 1 C and D), the symptoms were more or less identical. The earliest symptom of the disease, which appears when the fruits are small, unripe and hard, is the slight browning of a few cells in the central region of the fruit. As the disease advances, more and healthy tissues get involved. Due to the death and disintegration of the diseased cells, an irregular cavity is formed (Fig. 1 A), which gradually increases in size. The tissue lining the cavity is dry, hard and brown in colour and the seeds lying in this area become dry and blackened. There is a gradual transition from the dark brown diseased tissue to the healthy tissue. The diseased tissue retains its dry and dark appearance even after the fruit is ripened and pulpy. So far as investigation goes, this internal breakdown does not have any visible effect on the exterior of the fruits which in all cases so far observed were very fresh and healthy.

Separate isolations were made from the different regions of the diseased tissue and the apparently healthy neighbouring cells of each of the fruits. Some of these tissues were also subjected to microscopic examination for possible presence of bacteria or fungi. The results showed that all the fruits so far examined except one were free from any pathogenic organism. It was evident that in all these cases the disease was a physiologic one similar to that known as internal breakdown.

One of the fruits in which the disease had progressed far, however, gave in culture, bacteria and two kinds of fungi (Alternaria and Fusarium). The inoculation experiments with these isolated organisms have failed to reproduce the disease, which shows that this was also a case of internal breakdown but with secondary infection. The full paper will appear elsewhere.

The author is grateful to Dr. S. N. Das Gupta for his kind guidance.

Department of Botany, J. N. RAI.
The University,
Lucknow,
*August* 30, 1948.

1. Chardon, C. E., Miller, J. H., and Muller, A. S., *Phyllachora tropicalis on guava*, *Mycologia.*, 1940, **32**, (2): 172–204. 2. Das Gupta, S. N. and Rai, J. N., "Wilt disease of Guava." *Curr. Sci. August* 1947, **16**, 257–258. 3. Martyn, E. B., "Sun crack of guava." *Div. Rept. Dept Agric. Brit. Guiana.*, 1934–35 105–108. 4. Ruehle, G. D., "Algal leaf and fruit spot of guava. *Phytopathology*. 1941, **31**, (1): 95–96. 5. Uppal, B. N., "*Physalospora psidii* on Guava." A serious disease of guava in Bombay. *Int. Bull. Pl. Prot.* 1936, **10**, (5), 99.

## A MOSAIC DISEASE OF *LAGENARIA VULGARIS* SER IN THE BOMBAY PROVINCE

IN August, 1939, typically mosaic mottled plants of *Lagenaria vulgaris* were observed on the Agricultural College Farm, Poona. Records of investigation on its transmission, physical properties and host range showed that the disease in *L. vulgaris* was caused by a virus not recorded previously. The disease is quite common on *L. vulgaris* in the province causing appreciable damage to the crop. This note deals with the observations made so far on the various aspects of the disease.

The first symptoms of the disease appear in the form of well defined green mosaic with light-green and deep-green patches intermixed, in about 10 to 14 days after sap inoculation of healthy seedlings of *L. vulgaris* (Fig. 1). In young leaves the discolouration

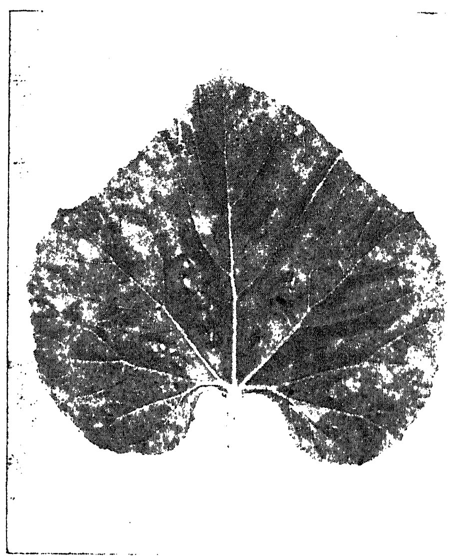


FIG. 1. A leaf of *Lagenaria Vulgaris* affected with the mosaic virus, showing typical mosaic symptoms

is quite distinct, but it gradually gets diffused as the leaf grows in size and age. Occasionally bright yellow or whitish chlorotic patches appear indiscriminately on the leaf lamina. Leaves are greatly reduced in size though not malformed. The diseased vines are thin, dwarfed and weak. Fruits set on diseased plants are usually small in size and less in weight as compared to those borne on the healthy plants, and often show severe discolouration in patches.

The virus is readily sap-transmissible and has been observed to be transmitted through seed in only two out of 824 plants raised in insect-proof glasshouse from commercial seed. In transmission tests with *Aphis malvae* Koch, which commonly breeds on *L. vulgaris* during summer, none of the 36 plants of *L. vulgaris* on which the aphid fed for 24 to 72 hours was diseased.

*The virus.*—The virus is stable in its physical properties. It stands heating for 10 minutes

at 95°C. but not at 98°C., retains infectivity at a dilution of one in a million and on storage for 308 days at laboratory temperature. It also withstands treatment with 95 per cent. ethyl alcohol for 24 hours and remains viable on desiccation.

*Host range.*—In addition to *L. vulgaris*, the virus readily infects *Cucumis sativus* L., *C melo* L., *Citrullus vulgaris* Sch., *C. fistulosus.* Stocks., *Luffa acutangula* Roxb. and *Tricosanthes anguina* L., *Cucurbita pepo* L. and *Momordica balsamina* L., though diseased, do not show visible symptoms and thus act as carriers of the virus.

*Benincasa hispida* Cogn., *Cucurbita moschata* Duch., *C. maxima* Duch., *Hibiscus esculentus* L., *Spinacia oleracea* L. and a number of species belonging to the families Solanaceae and Leguminosae could not be diseased when inoculated with the virus.

The mosaic disease in *L. vulgaris* dealt with in this note is caused by a virus quite distinct from the mosaic disease of bottle gourd described by Vasudeva and Lal.[1] On the other hand it closely resembles Ainsworth's cucumber green-mottle mosaic virus in respect of its host range restricted to Cucubitaceæ, inability to infect Solanaceous plants, and physical properties, but differs markedly in its ability to multiply in *Cucurbita pepo* which could not be infected with the green-mottle mosaic virus.[2] Accordingly, it is suggested that the mosaic virus of *L. vulgaris* be grouped with *Cucumis* virus 2 and designated as *Cucumis* virus 2 B according to the classification by Smith[3], and *Marmor astrictum* var. *lagenari* var. *nov.* according to the classification by Holmes.[4]

Further work on insect transmission is in progress.

Grateful thanks are due to Dr. B. N. Uppal for help and encouragement during the progress of the work. This investigation is being carried out under a scheme financed by the Indian Council of Agricultural Research.

S. P. CAPOOR.
P. M. VARMA.

Plant Pathological Laboratory,
College of Agriculture,
Poona, 5,
*August*, 14, 1948.

1. Vasudeva, R. S., and Lal, T. B, *Indian Jour. Agric. Res.*, **1943**, **13**, 182. 2. Ainsworth, G. C., *Ann. Appl. Biol.*, 1935, **22**, 55. 3. Smith, K. M., *Text-Book of Plant Virus Diseases*, *London*, 1937. 4. Holmes, F. O. Hand Book of Phytopathogenic Viruses, Minneapolis. *U. S. A.*, 1939.

## SEX CONDITION IN INTERSPECIFIC CROSS, *LUFFA AEGYPTIACA* × *LUFFA ACUTANGULA*

*Luffa œgyptiaca* ($n = 13$), the smooth loofah and *Luffa acutangula* ($n = 13$), the angled loofah, are monœcious. The difference between the two species is, however, very great in the stage at which the pistillate flowers appear.

In *L. œgyptiaca*, the female flowers come up at a very early stage soon after the appearance of male buds, at about seventh to tenth node, and both male and female flowers open more or less simultaneously whereas in *L. acutangula* the female flowers appear at a very late stage after a long interval when the plant fully establishes itself and male flowers commence opening profusely for sometime. The difference between the two species is thus well marked, *i.e.*, early appearance of female flowers in *œgyptiaca* and late appearance of female flowers in *acutangula*.

Inheritance of this sex condition was studied in the interspecific cross between the two species which cross readily, particularly with *L. œgyptiaca* as female and the back crosses. Other characters were also studied in the cross, not recorded here. The sex conditions observed in the parents and the hybrids have been designated as follows, for easy expression. The symbols M and F indicate male and female flowers respectively.

(1) (M−F) Appearance of male and female flowers simultaneously at the same node, from the beginning, *i.e.*, appearance of female flower, earlier than in *œgyptiaca*.

(2) (M F) Early appearance of female flowers soon after the male ones (*œgyptiaca*).

(3) (M + F) Intermediate condition of the appearance of female flowers, *i.e.*, earlier than *acutangula* and later than *œgyptiaca*.

(4) (M + + F) Late appearance of female flowers (*acutangula*).

(5) (M + + + F) Very late appearance of female flowers which appear in a very limited number (Hybrids with such a condition produced compact inflorescence, bearing comparatively small, circular and sterile male buds, very few of which developed to produce open flowers).

(6) (M) No appearance of female flowers, *i.e.*, such individuals are only male plants.

(*a*) *L. œgyptiaca* (female) × *L. acutangula* (male).

The $F_1$ hybrids could be distinctly classified into two types, nearly in equal numbers, *viz.*, (M F) with smooth fruits and (M + F) with angled fruits (intermediate condition). The former produced nearly cent. per cent. fertile pollen, whereas the latter showed a high percentage of sterile (empty) pollen. The two types also differed from each other greatly in a number of other characters.

The progeny (M F) hybrids in $F_2$ produced the same sex condition with smooth fruit, whereas the (M + F) ones gave $F_2$ hybrids which differed greatly, showing (M−F), (M F), (M + F) and (M) conditions in varying numbers :—

(M F) × (M++F)

$F_1$ (M F) 50% (M+F) 50%

$F_2$ (M F) 100% (M−F) (M F) (M+F) (M)

The $F_1$ data indicate the type of segregation one would expect in a cross in which one of the parents would be heterozygous for sex.

(*b*) The cross was repeated, and again in $F_1$ two distinct types were observed in nearly equal numbers, *viz.*, (M + F) with angled fruits (intermediate) and (M + + + F) with smooth fruits. This time a new type (M+++F) came up in place of (M F). It may be added that this new type looked nearly sterile and very much different from (M + F) individuals. Both of the types showed a high percentage of pollen sterility:

(M F) × (M+ +F)

$F_1$ (M+++F) 50% (M+F) 50%

This inconsistent behaviour observed in (*a*) and (*b*) might be due to different parent plants used of the same phenotypes.

(*c*) *Reciprocal cross.*

The cross, as a rule, is difficult to achieve, with *L. acutangula* as female. Only one crossed fruit was obtained after great efforts. All the $F_1$ hybrids showed only (M + F) condition with angled fruits (intermediate). A high percentage of pollen sterility was observed.

(*d*) *Back crosses* were attempted in experiment (*a*). $F_1$ (M + F) hybrids could not be crossed back with either of the parents, whereas $F_1$ (M F) ones crossed back easily. In both cases $F_1$ was used as female:—

(i) $F_1$ (M F) × $P_1$ (M F) *L. ægyptiaca*: Two $F_1$ hybrids were used and in both of the back crosses the hybrids produced were all of (M F) type with smooth fruits.

(ii) $F_1$ (M F) × $P_1$ (M++F) *L. acutangula*: The same two $F_1$ hybrids used in the above back cross were employed in this case as well with the same common male *acutangula* parent. Thus two back cross families were raised. In one of them the hybrids produced varied in their sex conditions as shown below in various proportion.

(1) (M F) with smooth fruits.
(2) (M + F) with angled fruits (Intermediate).
(3) (M+ + +F) with smooth fruits.

The (M + + + F) ones resembled in appearance the (M + + + F) individuals, referred to above, under (*b*) very closely:

$F_1$ (M F) × $P_1$ (M++F)

(M F) 50% (M+F) 25% (M+++F) 25%

Whereas in the other back cross family, only Nos. (1) & (2) appeared in nearly 75% and 25% respectively.

The details of these investigations with inferences and the cytological studies which have been in progress will appear elsewhere in due course.

R. H. Richharia.

Agric. Res. Institute,
Botanical Section,
Sabour, Bihar,
*Septemer* 9, 1948.

## INTERNATIONAL CONFERENCE ON STANDARDISATION

Dr. Lal C. Verman, Director, Indian Standards Institution, has returned from a three month tour in Europe, U.S.A. and Canada, where he attended a number of International Conferences and visited Standards Organisations in different countries.

At the Council Meeting of the International Organisation for Standardization (ISO) at Geneva, Dr. Verman represented India for the first time. A number of organisational problems concerned with the ISO were considered at this meeting and a Sub-Committee consisting of 5 nations including India was appointed to make recommendations concerning the constitution of the ISO. Rules of Procedure for international standardisation were also adopted for the guidance of various national standards bodies.

The ISO Technical Committee on Textiles met at Buxton, England, at which India was represented through a delegation consisting of Mr. Bharat Ram, Mr. B. M. Bagri, Mr. G. E. Longdin, Dr. Lal C. Verman and Mr. C. P. Halkatti.

*International recommendations for methods* of testing textiles represented one of the major items considered at this Conference. The proposal of the Indian Delegation for the adoption of a distinct Standard Atmosphere for textile-testing in tropical and sub-tropical countries was accepted as an International Recommendation.

The ISO Technical Committee on Documentation met at the Hague, Holland, towards the latter part of June, at which India was represented by a delegation consisting of Prof. S. R. Ranganathan (Leader), Mr. N. D. Gulhati, Secretary, Central Board of Irrigation, and Dr. Lal C. Verman. The Indian Delegation made important contributions to the deliberations of this Conference which related to a number of different aspects of standardisation on Documentation.

Dr. Verman made a particular study of the British Standards Institution, Canadian Standards Association and the American Standards Association. He also visited a number of research and testing laboratories and contacted organisations closely associated with standardisation activities in the various countries, such as for instance, the American Society for Testing Materials, Society of Automotive Engineers, American Petroleum Institute, etc.

The Indian Standards Institution having agreed to provide secretariats for International Committees on Mica and Shellac, Dr. Verman took this opportunity to contact British and American Committees dealing with these subjects. As a result of discussions held with these Committees and other interests concerned with the utilisation of Shellac and Mica in different industries, it is expected that the international work on standardisation in these fields will be greatly expedited.

# REVIEWS

**Cottonseed and Cottonseed Products—Their Chemistry and Chemical Technology.** Edited by Alton E. Bailey. Pp. xxiii + 936. (Interscience Publishers, Inc., 215 Fourth Avenue, New York 3, N.Y.), 1948. $ 17·50.

The book under review is a comprehensive treatise on all the aspects of cottonseed and is the outcome of the collaboration of twenty-five specialists. In the U.S.A., cottonseed was considered a useless material and even a nuisance in the early part of the 19th century. By the end of that century, however, this troublesome waste product was converted into one of the major cash crops of the States, especially the Southern U. S. Beginning from this century up to date, there has been further rapid progress in the scientific knowledge and technical processing of this oil seed. This treatise, therefore, gives "a broad treatment of the scientific principles underlying a great American Industry—an industry which is in fact a child of applied science" (page v).

There are five sections comprising twenty-five chapters in all. The first five chapters relate the story of the growth of cottonseed industry in the U.S.A. as well as in other cottonseed producing countries from the earliest times and thus give a comprehensive and comparative picture. This is followed by a detailed account of the structure of cottonseed, its various components, its biology and the chemistry of its pigments, proteins and other constituents. Methods of sampling, grading and evaluation of all the products have been traced from their early developments to the present day rational practices based on rigorous inspection, sampling and exact analysis. The next few chapters describe methods of processing cottonseed to obtain lint, hulls, oil and cake from it. The economics of cottonseed crushing is also discussed. The last section gives technical methods of transforming the edible and inedible products of the seed into usable commodities.

This is probably the first attempt to write an exhaustive treatise on a single oil seed. Naturally, in trying to be exhaustive, a part of the subject-matter has been repeated more than one time. Sometimes, the treatment has tended to be too elementary. Some chapters deal with the main subject only incidentally. Thus, the chapter "Nutritional Aspects of Cottonseed Oil" really discusses the "Role of Fat in Human Nutrition", as in fact is indicated by the sub-title of that chapter and therefore may belong to a book on nutrition or biochemistry. All of these, of course, are not errors of judgment, but are perhaps unavoidable features of a treatise. As remarked by the editor, the treatise "may (and will) profit a somewhat larger circle of readers than the average volume of science or technology". Many chapters may be read independently. As an illustration, the chapter on pigments of cottonseed will be found to be highly informative to the organic chemist and especially the colour chemist. In fact, the protein chemist, the nutritionist, the biologist, the cattle feed specialist and the oil-miller, each one will find something interesting in the relative chapters. The treatise is therefore strongly recommended as a worthy reference book on cottonseed.

Coming nearer home, it is a painful reflection that India, although it ranks second in cotton-seed production, has no cottonseed industry worth the name. Some solace may be derived from the knowledge that "the first record of the crushing of cottonseed to obtain oil or cake apparently dates back to the early Hindu writings" (p. 5), and that "As far back as about 300 B.C. a crude type of gin originated in India employing rollers which, when rotated close together, would pull the lint back between the rollers and leave the seed behind" (p. 10). However, at present, "among the major cotton-producing nations, India appears to be the only country where the bulk of the cottonseed is neither crushed domestically nor exported" (p. 53). The largest percentage is fed whole—lint included—to the cattle. It is hoped that this treatise at least will awaken the Indian oil-technologists and industrialists to a more rational use of this immense agricultural wealth.

Considering the size of the book, only a very few minor mistakes and misprints have crept in. Some of them are "Verda" for "Vedas" (p. 4, para 3, line 5), "principle" for "principal" (p. 105, para 1, line 5 and p. 183, para 3, line 7), "proceeding" for "preceding" (p. 183, para 3, line 3), "make up and bulk" for "make up the bulk" (p. 480, last para, line 2), "corkscrew-type" for "corkscrew-type trier" (p. 574, item 7 under D) and "Cis" for "trans" (p. 769, para 2, line 6).

The printing, the illustrations and curves have been neatly executed. The authors and the publishers are to be complimented on this welcome addition to the series of monographs on Oils and Fats.

J. G. KANE.

**"Textile Science".** By J. T. Marsh. (Chapman & Hall, Ltd., London, 1948.) Pp. xii + 388. Price 32 *sh.* nett.

Textile Processing is rapidly developing into a science and from this point of view, the title of the present book appears to be very appropriate. The book is full of valuable information, so many facts being condensed under one cover. From this point of view, it may be considered a valuable addition to the existing literature on the subject. From the reviewer's point of view, the book offers many difficulties. It is extremely difficult to decide as to which class of readers the book is directed to. We are told by the author that it is addressed to those with some education in science and who are training for a career in the textile industry. The book certainly cannot be followed by an uninitiated beginner. In parts, it is too elementary for the professional student. It is not

at all an easy matter to give views on the success with which the author has satisfied the needs particularly of those to whom he has addressed it.

The book is divided into four parts. Part I deals with the chemical constitution, molecular structure and physical and chemical properties of fibres. Part II is devoted to the mechanical processing of fibres, particularly their conversion into yarns and fabrics. The whole subject of spinning and weaving is condensed in only 34 pages. Part III deals with bleaching, dyeing and printing and Part IV with finishing.

A number of misprints occur in the text. For example, on page 49, line 27, wood for wool, on page 92 the expression: Physical properties of textile fibres *varies* with their moisture content. On page 216, potassium chromate is expressed as $K_2Cr_2O_4$, while on the same page, potassium perborate is expressed as $NaBO_3$ $4H_2O$. Several statements are either incorrect or not quite clear. The following few are given as illustrations. On page 243, line 13 "Anthraquinonoid colours *usually* give a deep blue vat", or on page 244, line 25 "......This is effected in the second stage of the dyeing process by sulphuric acid and sodium nitrite to give nitrous acid" or line 39 on the same page "......The reaction depends on the fact that suitable amines may be converted into diazo compounds by treatment with nitrous acid". Similarly, on page 379, line 19, "Chromium and iron can be applied by the impregnation with chrome alum followed by precipitation with sodium or potassium chromate". Many more can be added to this list. It is hoped that in the second edition of the book, all these will be attended to.

The book is well got up. The facts in the text are supported by many graphs and also a number of sketches of machines mentioned are included. It may be found very useful as a ready reference book giving useful information on almost all branches of Textile Technology.

G. M. Nabar.

**Radio Receivers and Transmitters.** By S. W. Amos and F. W. Kellaway. (Chapman & Hall, Ltd., London), 1948. Pp. xii + 356, 25 *s.*

We are witnessing the establishment and growth of a number of Polytechnics in India at the present period. The book under review should, therefore, find a ready welcome among the Radio Technology students of these institutions especially as the functions of the several sections and components of receivers and transmitters have been described and analysed with the aid of relevant mathematical formulæ. The subject of transmitters has naturally not received that detailed attention that has been paid to receivers. The highest frequency considered suitable for communication by Radio is taken to be in the neighbourhood of 45 megacycles per second. Television, too, finds a place in the book in the role of an important application of the principles of Radio transmitters and receivers.

The book opens with an introductory chapter that gives the reader a bird's eye view of its scope and contents. The next three chapters deal with the Inductance, Capacitance and Resonant and Coupled Circuits. The fifth chapter on the Propagation of Radio Waves and Aerials is the sketchiest and shortest chapter—under 20 pages—of the book. To give one instance, the topic of inverted V and rhombic aerials has been dismissed with a paragraph of less than 20 lines. The value of the book would have been considerably enhanced if this chapter had also been planned on the lines of the others. The three chapters that follow fully cover AF amplification, Detection; the Output Stage, the Loudspeaker, the Negative Feed back; RF amplification, Straight Receivers and IF amplification. The ninth chapter on Oscillators, Superheterodyne Receivers for AM, FM and Television contains a complete circuit diagram and a lucid analysis of a good commercial superheterodyne receiver, in addition to sections on other topics elucidated with equal clarity. The book concludes with a chapter of about 40 pages on Transmitters for Telegraphy, AM and FM broadcasts and Television. This is the only chapter without a bibliography. Seven short mathematical appendices and an index are also included.

In keeping with the authors' intention that the book is to be a bridge joining pure science and applied radio, no attempt has been made to derive all the mathematical formulæ used. On the other hand, the most commendable feature of the work is that there is hardly any formula in it whose significance has not been driven home with the help of worked examples in which representative numerical values have been substituted for the symbols. The practical student has to be grateful to the authors for the careful attention they have paid to this aspect of the subject. One of the few exceptions to this rule however occurs in the section on loudspeakers (p. 202) wherein the values of B in the air gap, the length of wire in the speech coil, etc., have not been given. Readers would also appreciate the actual decibels referred to a defined zero decibel marked against the Y-axis of the "Response curve of High grade Loudspeakers" (Fig. 132).

A somewhat serious misprint has crept in on p. 248 in connection with the equation for the Shot fluctuation voltage in a thermionic vacuum tube where I is stated to represent 'the anode current at any instant of time (R.M.S.)' while it ought to be the R.M.S. value of the random electronic current.

The bibliographies at the end of every chapter are worthy of note in two respects—one is that only important and relevant titles are referred to and the other is that the vast majority of them are British in origin. Scientists, writers of books on Science inclusive, claim science to be international and this latter, insular tendency is therefore certainly to be deplored. That a good number of American books, especially on Radio and allied subjects, similarly list references mostly to papers of American origin should not be regarded as a justification for others to adopt the same policy.

The book is neatly got up and is adequately illustrated with figures and plates. Its merits

outweigh the one or two defects commented on here and one can unhesitatingly recommend it for use by the class of readers for whom it is intended though it is priced rather high even for these days of soaring costs of production.

R. L. N.

**Power System Stability. Vol. I. Elements of Stability Calculations.** By Edward W. Kimbark. (John Wiley & Sons, Inc. New York), 1948. Pp. viii + 355. Price $ 6·00.

These are days of Grid systems. Small isolated power stations working at high cost, low efficiency and incapable of meeting peak-load demands, may be and are being harnessed to better and more economical use by inter-connecting such stations with other power stations forming a grid system. But this system of interconnection has brought in its wake very intricate and difficult problems of maintaining such a system with proper stability.

With such serious problems before them, electrical engineers naturally welcome any publication that might help them in their work. And when such an one comes from an author who was very closely associated with this type of work it is certain to be studied with great interest.

The book under review is only the first of the three volumes devoted to the study of Power System Stability, and it deals with the elements of stability calculations.

The first chapter states what actually is the stability problem and it has been explained by means of mechanical analogues. The second chapter deals with the swing equation and its solution. Swing curves have been drawn both from the formal solution of the equations and also from point by point calculation. The third chapter relates to the solution of networks. The method of reducing a network consisting of generators, transformers, transmission lines and loads, etc., to a simple circuit with impedances in series and parallel is given. Also in this chapter are described the General Electric A.C. Board and the Westinghouse A.C. Board, as well as the procedure in using the calculating boards. In the fourth chapter, the graphical method known as the 'equal area criterion' for determining if the system is stable under certain fault conditions is dealt with. Chapters V and VI deal with the fault-clearing time, determination of its critical value, factors affecting stability, and the solution of faulted networks.

The last chapter has very largely enhanced the usefulness and interest of the book by giving us four typical studies on stability. In each of these stability studies, the system and the contemplated changes are described and then the study to determine the factors causing instability of operation of the changed system and methods adopted to improve the stability have been exhaustively given.

The book is most welcome at the present time and is very worthy of a place in every electrical engineer's library.

B. N. N.

**Annual Review of Physiology—Vol. X, 1948.** (Published by the Annual Reviews Inc. and American Physiological Society.) Pp. xii+552. Price $ 6·00.

The Annual Review of Physiology aims at presenting topics in the form of reviews by scientists of highest rank throughout the world, although it is regretted that the present issue has achieved international authorship only in small degree. The volume is a record of the latest advances in several branches of Physiology and contains interesting series of articles on different subjects. A perusal of the contents show that the articles in this volume are written by well-known specialists. The authors have mostly confined themselves to literature survey during 1946-47, and have in accordance with the policy of the Editorial Board provided critical and integrated reviews of the subjects covered by them. In the article on 'Physical Properties of Protoplasm' Schmidt and Denues, lay special emphasis on several promising trends, particularly the application of information from precise physical investigations of model systems and the interpretation of observable physical properties of protoplasmic systems in terms of their molecular structure. The advances in genetics during recent years have been phenomenal and Beadle in his article on 'Physiological Aspects of Genetics' has chosen for special consideration several topics in physiological or chemical genetics. The chapter on Developmental Physiology is devoted to a discussion of the processes of development mainly from the biochemical point of view. The physiology of reproduction is the subject of an extremely interesting review by Reynolds.

The topics discussed in the volume cover, in addition to the familar subjects, a few new aspects of physiology: "Anoxia in Aviation" and 'Physiological Effects of Radiant Energy' represent two such topics. The problems of anoxic-anoxia and the relations of these problems to avitation had been studied during the War, but many questions of both practical and theoretical values remain unanswered. Such questions are of obvious importance to civilian avitation. Leslie F. Nims has critically examined these questions in the chapter on 'Anoxia in Avitation'. With the development of the atomic energy programme considerable impetus has been given to a study of the physiological effect of radiation and methods which might prove effective in preventing and treating the pathological changes induced by radiation. Dobson and Lawrence have attempted to bring out the highlights of recent development in this field in a highly suggestive chapter.

The volume is generously documented with references to literature. These reviews have become indispensable to a wide circle of investigators in the field of physiology and constitute an indispensable part of all Libraries interested in researches in their fundamental and applied aspects.

N. N. De.

**Hæmorrhage.** By Gregory Shawartzman and others. *Annals of the New York Academy of Sciences.* Volume XLIX, Art. 4, Pages 483-660. New York, 1948. Price $ 3·00.

This volume contains an interesting series of articles on hæmorrhage, and gives a critical evaluation and work-in-progress by eminent hæmatologists. It is valuable not only as a record of knowledge and accomplishment in this particular branch, but also as an incitement to research. As has been stated in the introductory remarks, certain pertinent investigations could not be covered in the volume, due to unforeseen circumstances; and the omission of such problems as erythroblastosis, cerebral hæmorrhage, and regeneration of the formed elements of blood and plasma following bleeding, are due to the fact that certain aspects have already been discussed at preceding conferences.

John H. Ferguson has given a masterly review of some basic facts of blood coagulation. Summarising the reaction of blood clotting and the rôle of calcium in clotting reactions and of phospholipid and thrombo-plastin in thrombin formation, the author gives reference of an unrecognised clotting factor, which is considered an important accessory factor in the conversion of prothrombin to thrombin. C. H. Best and L. B. Jaques in the discussion of "Heparin in blood clotting and thrombosis" have tried to throw some light on how to attack this problem. The relationship of vitamin K to hæmorrhage and coagulation has been discussed by S. A. Thayer. Discussing on the hæmorrhagic manifestation observed in experimental deficiency of pantothenic acid, choline and cystine, Paul György concludes that the syndrome in experimental deficiency of pantothenic acid in rats is due mainly to an underlying general blood dyscrasia, while the manifestations occurring in experimental deficiency of choline and in related conditions are caused probably by direct damage of the organs involved, especially the kidney and liver. There are valuable surveys, complete in themselves and covering very wide grounds on "The effect of hæmorrhage on circulation" by Dickinson W. Richard Jr., on "Experimental studies on traumatic and hæmorrhagic shock" by Magnus I. Gregersen and on "Vasomotion in Haemodynamics of the blood circulation" by Robert Chambers. The papers on "Reaction of peripheral blood vessels in Experimental Hæmorrhage" by Zweifach, Chambers, Lee and Hyman, "Metabolic changes associated with hæmorrhage" by Wilhelmi and Long and "Certain Anatomo-pathologic aspects of Hæmorrhage" by Klemperer are of the nature of survey of recent advances. Van Slyke discusses "the effects of hæmorrhage on the kidney" and points out that the relations between the central blood pressure, renal blood flow and glomerular filtration in shock caused by muscle trauma were similar to the relations noted in shock caused by hæmorrhage. The other articles deal with "hepato-renal factors in circulatory homeostasis," "hæmorrhagic manifestations of bacterial and virus infections" and "abnormal hæmorrhage with normal platelet count and normal clotting". "Clinical aspects of hypoprothrombinæmia" has been reviewed by Davidson and Tagnon. With the unfolding of our knowledge of the physiology of blood prothrombin and its relation to vitamin K, a better understanding has arisen of the disease associated with hypoprothrombinæmia, their diagnosis and treatment.

The editor as well as the contributors deserve the thanks of physiologist, biochemist and medical men for providing such a readable and informative volume. It will prove indispensable to all who are keen on the recent advances in the field.

N. N. De.

**College Zoology.** By R. W. Hegner. 5th Edition. (Publishers: The MacMillan Co., New York), 1947. Pp. xvii + 817., Price 25 *sh.* net.

R. W. Hegner is a well-known American author. The present edition of his *College Zoology* is an improvement on the previous one. Most of the chapters are re-written and a number of chapters on general principles are added. The author has made an attempt to convey to the student through this text-book a comprehensive picture of the subject as a whole. The author has incorporated modern views developed in zoological sciences in the recent years. The newer aspects of biology such as animal physiology and animal behaviour are brought in. The student is also made to understand man's place in nature.

Type method is followed as it is considered the best teaching device in animal study. Classification of each phylum is briefly given up to orders. As is characteristic of the author the leading characters of the various groups are emphasised in the form of numerical points. The anatomy is dealt with briefly. The black and white pictures are large, clear and numerous. The coloured plates are a great asset to the book. A naturalistic interest is created by a description of the habits of animals and the profuse illustrations showing animals in their natural surroundings. The closing chapter on the history of zoology and the pictures of eminent biologists published therein are fitting in their purpose. As an introductory text-book to the various aspects of zoology it is invaluable. That a fifth edition has been called for within five years of its first publication is sufficient commentary on the excellence and utility of the book.

**General Bacteriology.** By D. B. Swingle, revised by William G. Walter. 2nd Edition. (Publishers: D. Van Nostrand Company, Inc., New York; Macmillan & Co., Ltd., London, 1947,) Pp. 311. Price $ 3·50.

The present volume is a revised edition in General Bacteriology which first appeared in 1940. The revised edition is the work of William G. Walter, Associate Professor of Bacteriology at State College, Montana. In conformity with the objects outlined in the first edition "to produce a book that will give the student a wealth of information in a form that is within his comprehension", the present revised volume by Walter amply justifies the hopes raised in the first edition.

A general outline of the book reveals that the scope of the book is enlarged to fit in allied subjects such as trends in antibiotics, disinfection and sulfonamides. The book is divided into 24 chapters, dealing with the early history of Bacteriology and passing through chapters on classification, culturing and nutrition of bacteria. There are independent chapters devoted to each of a large number of subjects such as Bacteria in soil, water, sewage, oil, milk, and foods.

The closing chapters of the book are largely devoted to mechanism of infection, Immunity Reactions and Pathogenic Bacteria finally ending with the last chapter on Viruses and the Bacteriophage. The author is to be congratulated for the wide range of subjects he has covered in such short space with clarity and brevity. The book will be a very useful addition to every student who wants to begin the study of Bacteriology.

T. N. R.

**Five Hundred Varieties of Herbage and Fodder Plants, being Bulletin No. 39 of the Commonwealth Bureau of Pastures and Field Crops, Aberystwyth, Great Britain** and edited by M. Hall, 1948. Pp. 328. Price 15 *sh.*

This Bulletin comprises a list of 500 plants which furnish fodder in one form or another and summarises information received about them from correspondents in different parts of the world. The information is brought together under definite heads, *viz.*, Origin, authority, characteristics, adaptation, resistance, use, certified or not, grades recognised, authority for certification, and if available in open market. The information relates to Australia, Canada, Finland, Great Britain, Netherlands, India, New Zealand, Norway, Palestine, Sweden, South and East Africa, and Trinidad. Notable and obvious omissions are Soviet Russia, the U.S.A., South America and Denmark. The list is intended only as a first attempt and is expected to be added to from time to time. Some hints on the cultivation side will enhance the usefulness of the book, such as soils suited, seed rate and method of sowing, whether fit for grazing, hay making and ensilage, number of cuts and yield of green fodder or hay, etc., in the same way as a list of the fodder crops of Brazil is being published by the Department of Agrostology of that country, and we suggest this addition in a later edition. The list includes a large variety of fodder crops, grasses, roots, many of the grain crops, leguminous fodder crops and so on, and may in that respect be said to be comprehensive. Some of the fodder grasses and crops of India also receive attention among which we notice, the fodder jowar varieties, *Cynodon dactylon, Cenchrus ciliaris, Dolichos lablab, Eleusine* spp. and others. *Carthamus tinctorius* is also included which is too spiny and repellent as cattle feed and is indeed grown in the margins of other crops in order to keep cattle away; it is however stated to be used for ensilage while the seed of course yields both oil and a well-known edible oil-cake. The contents of many of good Indian lists of fodder and other grasses like Prof. Rangachari's for South India, Prof. R. G. D. Graham's for Nagpur, Symond's 'Indian Grasses', and the lists compiled in the grass surveys of some of the Provinces recently deserve to be summarised in this way and we suggest this work to the departments of Agriculture in India. The Bulletin under review is a useful contribution to the literature on fodder grasses and crops.

A. K. Y.

**Soil and Water Conservation in the Punjab.** By R. Maclagan Gorrie. 1946. Pp. 290. Price Rs. 5. (Place of printing or publishers is not mentioned.)

In recent years a good deal has been written and said on the subject of soil and water conservation in India. Most of it describes more of experience elsewhere than of experience in India. The publication, under review, by Dr. Maclagan Gorrie of the Indian Forest Service, makes a departure in this respect and describes in detail, the practical field operations, under Dr. Gorrie's supervision, on soil and water conservation in the Punjab. Although the publication deals with a specific problem in the Punjab, the details of field operations will be of instructional value to those engaged on similar work in other parts of India.

Soil erosion is a universal and natural phenomenon, which is as old as the earth itself. It is brought about by rain and wind. Of primary importance, because of its gigantic scale, is that brought about by the flow of natural rainfall. The configuration of the surface of the earth today, with its large meandering rivers, fertile plains and deltas is the result of rainfall and erosion through geological time. As gigantic tectonic forces convulse and heap up large masses of land into mountains, rainfall erodes them into plateaus and valleys carving out rivers and forming extensive plains and deltas, which support huge populations of men and animals. The vast Indo-Gangetic plain and the extensive deltas with their teeming populations, are the children of soil erosion.

Vegetation slows down erosion and ultimately brings about a stage at which the natural processes of water regimen and soil erosion are stabilised. The interference by man and his animals for cultivation, upsets this balance of nature and this is followed by accelerated soil erosion and greatly disturbed water regimen. Cultivation is necessary for man to live. Man must, therefore, destroy forests and vegetation and reclaim land and thus upset the geological equilibrium. All this is a necessary and unavoidable evil which man must inflict. But the evil can be minimised and partly repaired with the aid of science and common sense. Afforestation and encouragement of vegetation do not entirely stop soil erosion. It goes on but only on a moderate scale. It controls, if not altogether prevent, the loss of good fertile soil—a loss to the individual who has been endeavouring to make a living from agriculture and in the aggregate a gigantic loss to the nation.

It was in the U.S.A. that the cry against erosion was first loudly raised two or three decades ago, and a huge organisation has been set up to fight soil erosion. Other countries soon took up the cry and today every country is "erosion minded" with varying degrees of action and talk. It should be noted that although Britain is the pioneer in the field of agricultural science and in the application of science to land management and crop production with impressive results, that country did not in the past lay emphasis on soil erosion. Nor does Britain even today take steps on a scale comparable with that in the U.S A. or Australia.

It is not because that soil erosion does not occur in Britain. It is largely because that in Britain the natural forces of erosion and systems and practices of agriculture had attained a balance several centuries before the U.S.A. or Australia or Africa began systematic exploitation of land. Agriculture, as we understand it today, began in these countries only two or three centuries ago by clearing forests and exploiting the virgin highly fertile soil. The accumulated fertility of ages began to be washed away and the introduction of modern methods of agriculture, intensively and extensively after World War I, accelerated erosion with disastrous results. Several farmers have had to abandon what were once fertile farms and to seek new land. This is "shifting agriculture" under modern conditions and does not materially differ from that of the primitive. This rapid loss in a few decades of what is accumulated through ages is the cause of the justifiable cry in the new countries. This is of significance to India and to the appraisal of Dr. Gorrie's publication under review.

In India, land exploitation and agriculture are of great antiquity. The adjustment of, and the balance between natural conditions and the agricultural systems attained a reasonable state of equilibrium long ago. Conditions of rainfall are such that precipitation is limited to a short period, and the result is, more often than not, drought or deluge in some large section of the country, so much so, that Indian budgets have the notoriety of gamble with monsoon. The fact that rice cultivation occupies by far the largest proportion of arable land is significant. Even more significant are the tanks for storing water, and the rice fields and their methods of cultivation which, under the circumstances are the most efficient methods, of conservation and utilisation not only of water delivered without notice and in unpredictable quantities but also in retaining lower down, the soil and silt eroded above, and preventing it from going into the sea. This is eloquent testimony to the understanding and controlling and conserving water and soil through several centuries by generations of farmers.

The significance of this seemingly commonplace and unimportant observation is that as Dr. Gorrie and many others consider, the water and soil conservation problems, of India cannot be solved only by the obvious method of dealing with the problems at the source without examining the repercussions in the established order of things lower down. India has to deal with the ills of ages. She cannot with impunity apply the *ad hoc* remedies found suitable for the young and expanding land utilisation and agriculture in newly colonised countries. It must be a process from part to the whole towards the top. The geological balance as such and in relation with the locally established agriculture and practices, should be investigated in the different catchment and agricultural areas of the country, paying regard to the contribution to acceleration or check made by good, bad, and indifferent farmers in the locality.

As has been stated already Dr. Maclagan Gorrie's book deals more with a specific problem under certain conditions than with a complete programme. Its chief merit lies in the detailed description of the practical aspects of the work with facts and figures. These will be found instructive and valuable to those who have to deal with soil and water conservation in India and Greater India.

B. V. N.

## PROCEEDINGS OF THE ZOOLOGICAL SOCIETY OF BENGAL

THE *Proceedings of the Zoological Society of Bengal* is a new biannual Journal of Zoology published from Calcutta. The first number (March 1948, Rs. 10 or 10 sh.) which we have received contains eight original papers, mostly from the Zoological Department of the Calcutta University. Two papers deal with meiosis in the Acridiidæ. The other subjects covered include development of scales in *Glossobius*, bionomics and development of *Ophiocephalus striatus* and myxospordians from fishes. Mukerji and Mitra report the results of their experiments on the control of the termite *Odontotermes redemanni* giving the strengths of successfully used insecticides and conclude that the best results could be obtained in Bengal and Bihar if the insecticides are applied during the February-April period especially to reduce the immature reproductive forms which usually appear in March. Mookerjee and Bhattacharya give an account of the development of the Vertebral column in *Alligator mississippiensis* in continuation of Mookerjee's former work on the formation of the vertebra in other reptiles and batrachia.

The Journal is neatly printed and well produced and the illustrations are of a high order. Even though there are many journals in India devoted to Zoology and Natural History, increased output of work from Universties and Institutes has created the need for new avenues of publication. While welcoming this new Journal we hope the standard of publication will not be allowed to slide down, but effectively maintained and we wish this Journal a successful and un-interrupted career devoted to the cause of Zoology in India.

# SCIENCE NOTES AND NEWS

## Olympic Torch

This year it is Great Britain's turn to stage the Olympic Games and among the many problems for an event of such world-wide interest and importance, was the design of a torch to be carried by relays of runners across Europe from the plain of Olympia to Wembley Stadium in London.

In December 1946 the Fuel Research Organisation of the D. S. I. R. was approached by E. J. Holt, Esq., O.B.E., of the Organising Committee of the XIVth Olympiad for assistance and advice on the design of a torch and on the most suitable fuel. It was essential that the torch should be of light weight as it had to be carried for about 15 minutes by each runner (about 1,600 runners would be required on the route across Europe), and the torch would require to be so constructed that the fuel would burn under the most difficult weather conditions. The fuel employed had to be easy to ignite, while at the same time involving no high fire risk, as the torches would have to be transported and stored at numerous places on the route some time before the commencement of the run. It was also necessary, to ensure that each new torch could be lit easily and with certainty from a preceding torch; it was also desired that the fuel should give a visible but not very smoky flame.

This problem was undertaken by the Fuel Research Station and the actual investigation was carried out by Dr. L. R. B. Shackleton. Many different types of fuel were examined in torches of various designs made up from sheet metal. Finally it was decided that the most suitable fuel was hexamine in the form of tablets. Hexamine gives a non-luminous flame, and to make the flame visible in all weathers 6 per cent. of naphthalene was added.

Prototype torches made at the Fuel Research Station were tried out by runners, first from the South London Harriers and, after certain modifications in design, by Officers from the Royal Naval College, Greenwich. The requirements of the Organising Committee were fulfilled in final trials at Greenwich, and the prototype torch was submitted to Commander F. W. Collins, R. N. (Retd.) who was responsible for the arrangements for the manufacture and distribution of the torches, and for the run across Europe.

In the final design of the torch seven tablets were enclosed in a perforated metal cylinder with an inner sleeve concealing the lower three tablets. As the upper tablets burned away, the lower reserves were forced up into the burning zone by a spring. In order to facilitate lighting, the Wessex Aircraft Engineering Co., Ltd., Salisbury, provided a tablet of nitrate composition which was introduced on top of the fuel pack. A quick-match, provided for ignition, protruded through the perforated container.

One or two final refinements were introduced at the concluding stages to safeguard the effectiveness of the torches during transport to the various countries through which the relay runners had to pass. The fuel tablets were totally enclosed in a nitro-cellulose cover provided by Cascelloid Ltd., High Holborn, London. This cover burned immediately on ignition leaving no carbon residue. The perforated metal fuel container was also capped and sealed with adhesive tape. Both of these precautions were considered necessary to preserve the fuel and to avoid any risks of accidental ignition.

## Oil Position in India

The oil position in India has been examined by Dr. D. N. Wadia, Director, Indian Bureau of Mines in an article in the latest issue of *Indian Minerals*.

After discussing the history of the oil industry in India and the prospects of the various oil-fields, the author observes:--

"Oil exploration in India is yet at an early stage, fitful and defective, although it began in 1800 in Arakan, in 1820 in Burma and in 1870 in the Punjab; but the history of oil exploration in India is one long record of failures and disappointments. In proportion to millions of rupees spent in India for search, discovery of new oil-fields has been very costly and slow. Oil exploration and development is an extremely expensive and risky enterprise, beyond the means of any but powerful Corporation with large and widespread resources in capital and technical knowledge. But intensive geological exploration supplemented by geophysical prospecting, notably by seismographic reflection and refraction methods and by gravity determination by the Torsion balance and the more modern gravity measuring instruments remains to be done in many areas. Till this is accomplished, it is not possible to form any correct estimate of India's petroleum resources."

## Synthetic Mica

According to Dr. Lal C. Verman, Director, ISI., who has just returned from a study tour of the Continent and the U.S.A., manufacturers of electrical machinery are now making use of silicone-bonded glass cloth in place of mica. More important still is the fabrication by a Swiss technologist of "Mica Powder Film", a composition made from cheap mica powder. A factory is reported to be planned for producing "Mica Powder Film" on a large scale. When commercially available, this mica-substitute, it is said, can successfully compete with natural mica in the manufacture of electrical tape.

Another recent development is that of synthetic mica, which is the subject of intensive experiments by the U. S. Army and Navy. The process which requires only cheap raw materials, is reported to have reached the stage of pilot plant experimentation. If successful, this process will be capable of producing mica crystals of sufficiently large dimensions to compete with the natural product.

American users of mica have complained that they are being forced to look for substitutes for mica largely because of the uncertainity of quality and lack of uniformity of supplies of the mica imported from India. The manufacturers of electrical goods feel that export from India of mica of acceptable standards of quality and sizes would help to maintain the present large and persistent demand for this valuable mineral.

The average annual export of mica from India is 11,250 tons valued at Rs. 217 lakhs, most of which represents hard currency (U.S. dollars).

The International Organisation for Standardisation (ISO.) has entrusted the Indian Standards Institution with the secretariat of an International Committee to develop internationally agreed Standards on Mica. Foreign countries, which are large importers of mica, have offered full co-operation in drawing up standard specifications. Strict conformity to standards is bound to put this important Indian mineral industry on a sound and scientific basis.

## The Geological, Mining and Metallurgical Society of India

The 24th Annual General Meeting of the Council of the Geological, Mining and Metallurgical Society of India was held on 10th September 1948 at Calcutta when Dr. S. K. Roy presided and His Excellency Dr. K. N. Katju, the Governor of West Bengal, was the chief guest of honour.

## Association of Scientific Workers in India

Addressing the scientific workers of the Institute of Science, Bangalore, Prof. P. M. S. Blackett, F.R.S. (who is now in India to advise the Ministry of Defence in the building up of a sound scientific organisation) stressed the importance and the need for an Association of Scientific Workers in India for the purpose of safeguarding and promoting their interests. Referring to the work and activities of the Association of Scientific Workers in England, he said that its objectives were, firstly, to organise as a trade union and secondly, to educate the Government and the people in the knowledge and philosophy of science. He spoke on the advantages of trade unionism for scientific workers as much for the recognition of their rights as also for the abler performance of their noble obligations to mankind. He expressed the hope that the members in the audience would join the association in large numbers and thereby help the cause both of humanity and science.

## The Aeronautical Society of India

A meeting was held in the Air Transport Licencing Board Hall, on the 31st July 1948, at 10 a.m., under the chairmanship of Mr. N. C. Ghosh, Director-General of Civil Aviation in India. A distinguished gathering of scientists, engineers and prominent airline officials was present.

The members present constituted themselves into a Society named the Aeronautical Society of India with the main object of promoting the advancement and diffusion of knowledge of the aeronautical sciences and aircraft engineering and the elevation of the aeronautical profession.

Mr. N. C. Ghosh was unanimously elected the President of the Society, with Dr. V. M. Ghatage as Vice-President, Mr. S. C. Sen as Honorary Treasurer, and Dr. P. Nilakantan as Honorary Secretary.

## National Institute of Sciences of India

The following awards of Research Fellowships have been made by the Council of the National Institute of Sciences of India:—

*National Institute of Sciences Senior Research Fellowship.* 1. Dr. J. Bhimasenachar (Physics), Andhra University, Waltair. 2. Mr. S. Chatterjee (Physics), Bose Institute, Calcutta. 3. Dr. B. D. Tilak (Chemistry), Bombay University, Bombay. 4. Dr. L. S. Ramaswami (Zoology), Mysore University.

*National Institute of Sciences Junior Research Fellowship.* 1. Mr. U. Burman (Methematics), Calcutta University. 2. Mr. B. K. Banerjea (Physics), Calcutta University. 3. Mr. K. Das Gupta (Physics), Calcutta University. 4. Mr. P. C. Mukherjee (Chemistry), Calcutta University. 5. Mr. S. Veda Raman (Chemistry), Indian Institute of Science, Bangalore. 6. Mr. Y. Sunder Rao (Botany), Government College, Hoshiarpur. 7. Mr. S. D. Misra (Zoology), Lucknow University.

*Imperial Chemical Industries (India) Research Fellowship.* 1. Dr. R. G. Chatterjee (Chemistry), Calcutta University. 2. Mr. K. Venkateswarlu (Physics), Andhra University, Waltair. 3. Mr. T. V. Deshikachary (Botany), Madras University. 4. Mr. J. Mitra (Botany), Calcutta University. 5. Mr. T. V. R. Pillay (Zoology), Zoological Survey of India. 6. Dr. C. V. Subramanian (Botany), Madras University.

## Draft Indian Standard for Shrinkage Test

The Indian Standards Institution announces the compilation of its first draft standard in the domain of textiles. It is entitled "Draft Indian Standard for Method of Test for Shrinkage of Woven Cotton Cloth in Laundering", and has been prepared by an expert Sectional Committee of the Textile Division Council of the Institution.

The object of the test specified in this draft is to provide an agreed method of estimating shrinkage on laundering of woven cotton cloth, in order that the manufacturers may be able to make due allowances in every type of fabric produced by them.

The draft, based on the corresponding specification issued by the American Society for Testing Materials, describes the scope of the Test, the apparatus to be used, preparation of test samples and method of conducting the Test for shrinkage after laundering.

This draft on Shrinkage test of cloth after laundering has been widely circularized to industrialists and technologists in the Textile field. Comments will be received till the 23rd of November 1948, by the Director, Indian Standards Institution, 'P' Block, Raisina Road, New Delhi.

Editor: M. Sreenivasaya, B.A., F.I.I.Sc., F.A.Sc.
1012-48 Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore

Current Science

Vol. XVII] OCTOBER 1948 [No. 10



# MUSEUMS OF THE UNITED STATES OF AMERICA

IT has often been said that one standard by which the prosperity of a country can be judged, is the number and quality of its museums. The United States of America is by this standard, easily in the forefront of prosperous nations, for her museums are ahead of those of any country the writer has visited in exhibition, exposition and research. They are today dynamic educational institutions. Their role is to raise the level of life of the average man by increasing his knowledge and placing within his reach opportunities for creative work. They stimulate the young minds of the children, yoke their exuberant energies to profitable pursuits and provide them with interests other than those provided in schools which help them subsequently to make contributions of outstanding value in the fields of Science, History or Art.

Generally speaking, the museums of the States could be broadly classed into ten groups—Science Museums, Museums of Science and Industry, Art Museums, History Museums, Historical Site Museums, Planetaria, Trailside Museums, Travelling Museums, Park Museums and Children's Museums. The American Museum of Natural History in New York and the Museum of Natural History in Chicago, up till lately known as the Field Museum of Natural History, are famous examples of Science Museums in the U.S.A. The former is accepted to be the largest and finest in the world. The Buffalo Museum of Science in New York State, though small compared with the two just mentioned, is a fine example of a typical Science Museum. These institutions are devoted to the illustration of the sciences of Zoology, Botany, Geology and Anthropology. Astronomy is also a favourite subject in most Science Museums. The American Museum of Natural History has the Hayden planetarium attached to it which is devoted to Astronomy. In Chicago,

the Adler Planetarium fulfils this function, but it is a separate institution from the Museum of Natural History. The Buffalo Museum has a small Observatory with an eight-inch refracting telescope on the roof of the building. Most Science museums, like the Cleveland Museum of Natural History and the Cranbrook Institute of Science have strong Astronomy sections in their exhibition Halls. The Buffalo Museum of Science in addition, has sections in Physics and Chemistry, Meteorology, Numismatics and Art. A small aquarium and a vivarium are also a feature of many Natural History Museums. The American Museum of Natural History has a section devoted to live insects.

Museums of Science and Industry on the other hand, are devoted to subjects like Physics, Chemistry, Power, Fuels, Metals, Medicine, Agriculture and Transportation. The museums of Science and Industry in Chicago and New York and the Franklin Institute of Philadelphia are among the chief institutions of this type. These museums are said to have been inspired by the great Deutches Museum in Munich which is recognised to be the first museum in the world to present exhibits of this kind. In the Museum of Science and Industry in Chicago, the writer saw an operating coal mine, complete in every detail, a model of an electric railroad, 3000 ft. long, illustrating all the operating problems of a modern transport system; a print shop, iron foundry and industrial processes like oil refinery, phases of automobile manufacture, etc. In the New York Museum of Science and Industry housed in the R. C. A. building in Rockfeller Centre, subjects such as Transportation, Electrotechnology, Communications and Power Transmission are illustrated among other things.

Then there are the Art and History Museums, and in addition, what are called Historic site museums or out-of-door museums in History. Many old buildings of great interest, sites famous in history, thus function now as museums, inviting the attention of the public to the significance of these places. The Fort Niagara Museum in New York State and the Ursuline Monastery of Quebec in Canada are examples of this type of museum which the writer had occasion to visit. Similar museums in the field of Natural History are called Trailside Museums. The Bear Mountain Trailside Museum, the Trailside museums of the Cleveland Museum of Natural History and the Trailside Museum in the Redwoods Park, California, are examples. In these instances, a woodland trail is maintained along which trees, shrubs and herbs, rocks and other natural objects are labelled. Apart from these trails, there are actual museums located in the National Parks which are devoted solely to the illustration of the Natural History of the Parks.

Travelling Museums are another type which are coming more and more into prominence today in the U.S.A. These museums are installed in trailer units attached to automobiles. The one the writer saw belonged to the Children's Museum in Washington D.C. The trailer contained exhibits arranged on shelves, of scenes from India, China and Poland, minature models of various national types and books and pamphlets describing them. It was touring the country stopping in market-places and public parks to show their exhibits. The writer saw a similar one belonging to the Cleveland Museum of Natural History. It carried exhibits illustrating the migration of birds, the storage of food and hibernation on the part of mammals, and such phenomena as the scattering of seeds and the shedding of leaves by trees and other kindred subjects.

The planetarium is a very interesting institution devoted to Astronomy. The first of its kind to be established in the U.S.A. is the Adler Planetarium of Chicago, founded in 1930. Other famous planetaria are the Hayden Planetarium in New York mentioned above, the Buhl Planetarium in Pittsburgh, the Fels Planetarium in Philadelphia and the Griffith Observatory and Planetarium in Los Angeles. The Planetarium chamber is circular in shape and has a hemispherical ceiling. On the floor, towards the centre is located the planetarium instrument and seating facilities for the audience. With the help of the instrument, the demonstrator projects the sun, moon, planets and stars on the ceiling of the darkened chamber, so that the spectators get a clear view of the various aspects of the heavens, at any period in the past, present or future.

Finally, there are the Children's Museums devoted exclusively to subjects of interest to children. They are quite large in number and are distributed throughout the country. Then there are a few museums such as the museum of the American Numismatic Society, New York, The National Academy of

Design, New York, The Cleveland Museum of Health, The Mariners' Museum in Hampton Roads and the National Baseball Museum in Cooperstown, New York, which although devoted to special subjects are in reality the elaboration of any one of the topics covered by museums of Science, History or Art.

Whatever be their field, the exhibition programmes of museums today in the States is designed to educate the public. Education is their primay function. This marks a definite phase in the evolution of museums. In the first stage, they were a store-house of curiosities, assembled together by men of means and leisure, but with no definite purpose in view. Later, when the collections grew in size and importance, they became the subject of study, identification and classification. Many of the specimens of no particular interest were discarded, the museums lost their nature of 'old curiosity shops' and the collections came to be displayed, all of them, in neat, orderly series. Most museums of the world, including ours in India, with the exception of the Prince of Wales Museum in Bombay, are in the second stage of development. In the United States of America, they have gone a step further. They have removed most of their collections into storage rooms exhibiting only those of a more educational nature and of more popular appeal. The guiding principle in their exhibition methods is the use of specimens only in so far as they serve to illustrate an idea and not exhibit them, merely for the sake of exhibition. Thus the American museums could be described as museums of ideas whereas our museums are essentially museums of objects.

In planning museums, the types of visitors who are likely to visit the museum in greater numbers is taken into account and the exhibition programme modified to meet their needs. Invariably, they are designed from the point of view of the common man with no previous knowledge in the subject. Due consideration is also given to the needs of the child visitor, for whose sake exhibits are placed low enough. Even labels are so prepared that the child can easily read and undestand them. For the more advanced visitor, the collections in storage are organised into neat, orderly, easily accessible series. Visitor comfort and visitor reaction are subjects of study by museum planners, who make use of the results in making fresh installations or altering the existing exhibits. Restful seats here and there in the galleries, to relieve the protesting feet of visitors are a common feature of every museum today.

An uderlying principle discernible in the selection of topics for illustration in Science museums is that they should, through their exhibit programme, give the average visitor some idea of himself and his environment. This would involve a detailed knowledge of his country in relation to the world : some idea of it in space and time and its niche in the world's economy ; facts relating to its mineral, agricultural and human resources ; its fauna, flora and geology, against a background of the animal and plant life of the world, past and present ; the life and culture of the primitive peoples ; the contributions of the various social groups to general culture and progress, also the story of the development of civilization and finally the common problem of everyday science with a section on health and how to take care of it. Any other scheme by which indispensable information of this type could be given to the masses is possible, provided the museum knows how to present them. Having chosen the topics, they are illustrated as attractively as possible, bestowing attention to such factors as the treatment of walls, lighting, size and shape of showcases and format and placement of labels. The dictum "more art in Science museums and more science in Art museums" is nowhere truer today than in the museums of the U.S.A.

These installations are of a permanent nature. However attractive they are, after a time they become static and dull. People feel that there is nothing more to see in the museum. To prevent this, temporary exhibits of topical interest are held in most museums. At the time of the writer's visit to the Buffalo Museum, there was on show for a short period, an exhibition of jokes at the expense of museums. This consisted of an extraordinary collection of cartoons and caricatures featuring museums and their activities and proved a tremendous success. At the American Museum of Natural History two such exhibitions were in progress at the time the writer was there ; one related to Atomic Energy and the other, entitled "From the Neck up" was a very interesting and stimulating display of the head adornments of the various peoples of the world. Temporary exhibitions of this kind go very far in removing the dullness that accompanies permanent installations.

Whether the exhibition be temporary or

permanent, the resources of modern technology and skilled craftsmanship are available to make it attractive. Large halls are usually broken up into alcoves and a colour scheme harmonious with the specimens and show-cases is adopted for the treatment of walls and ceiling. Murals, closely related to the topics illustrated are used wherever possible. It is a common practice to light individual cases with fluorescent lamps, leaving the exhibition halls comparatively dark. Labels are also prepared in keeping with the attractiveness of the general layout. A tendency to have them handwritten in preference to typed or printed is noticeable in several museums. Monotony and dullness are recognised as the two major enemies of attractive display and every effort is made to overcome them.

The dominating attraction of all Science museums and most Historical museums today, however, is the Diorama or Habitat group. It has reached a very high standard of excellence in the American Museum of Natural History, New York, the Natural History Museum, Chicago, the Academy of Sciences, Philadelphia, in the San Francisco Museum and the Denver Natural History Museum. The Bison group and the Bear group in the Buffalo Museum of Science are excellent. The degree of realism attained in these types of display is wonderful. In some instances, to add to the realism, running water, gusts of wind and even the aroma of field and forest at the particular season in which the show is laid, are introduced! The modern diorama is a marvel of creation and involves the combined skill and life-time experience of artists, photographers, plant modellers, animal sculptors, tanners, electricians, cabinet makers, smiths and other technicians. The cost of such a habitat group naturally runs into several thousand dollars.

In some museums, where cost is a great consideration dioramas have been made in miniature with as good results. They are so accurately done to scale, that the onlooker fails to realise that the scene he is watching is a miniature reproduction. The African Waterhole group in the Buffalo Museum of Science comes to the writer's mind in this connectoin. The same group is exhibited in life proportions in the African Hall of the Academ of Sciences, California, and the African Hall of the American Museum of Natural History. He feels that what they have achieved at enormous cost is not very much greater than what the Buffalo Museum has achieved with its miniature reproduction of the same group at a fraction of the cost.

Just as everyday objects sometimes look very attractive in miniature, in some cases, they have a fascinating interest if enlarged several times to outsize proportions. Thus the familiar models of the house fly and bed bug in some of our museums, are enlarged not only for the sake of magnifying its small body parts to aid our vision, but to make for attractiveness also. In the Cleveland Museum of Health are exhibited outsize models of the human Ear and Mouth which seldom fail to draw admirers. The discrete use of miniatures and outsize models, of mirrors in producing an illusion of depth, where it is not possible otherwise, illustration of objects in the flat by cut-outs from suitable material are some of the methods which museums employ to make their displays interesting.

There is yet another device in use on an extended scale in most museums—the introduction of mechanical exhibits which could be operated by the visitor. In the Rochester Museum of Arts and Sciences, the exhibits illustrating the manufacture of glass is to be operated by the visitor. When he pushes a button, the concealed mechanism starts to life and the whole series of processes in the manufacture of glass pass in their sequence, before his eyes. In the Buffalo Museum, the actual rattling of a rattlesnake is made audible to the visitor by the mere pressing of a switch. In another case, illustrating the life of a cave, the visitor has to "on" the switch before the bats, salamanders, newts and other animals exhibited in the darkened cave, will become visible, one after another.

Unlike our museums, the exhibits of almost every American museum are supplemented by a well organised educational programme, by which it offers educational facilities to the people, young and old. The following list of the educational activities of the Buffalo Museum is typical and would serve to show the extent and possibilities of this aspect of museum work.

A. *For Children.*—

1. Conducted tours for school children within the museum during school hours.
2. Saturday morning story hour for six year olds.
3. Saturday morning Nature Sketch classes.
4. Saturday afternoon courses for older children in simple Astronomy, Birds, Trees, Reptiles, Minerals, Geology, etc.
5. Field trips—Nature Hobby clubs.

6. Saturday afternoon Craft clubs—when children who show interest are taught crafts like wax or clay modelling, plasticine work, leaf printing, casting in plaster, soap carving, etc.
7. Saturday afternoon Music appreciation classes.
8. Eurythmics.
9. Lending teaching aids to schools such as Exhibits, Lantern slides, Microscopical slides, Music records and Scores, Nationality dolls, Maps, Flags, Pictures and finally, Sound and silent films on educational topics.

B. *For Adults.*—

1. Regular courses in a number of practical subjects such as Sketching, Photography, Shell craft, etc., organised by the staff and held in the museum during evenings.
2. Promotion of Clubs like the Conchological, Microscopical, Botanical, Bryological, Horticultural, Astronomical, Geological, Photographic, Archæological, Ornithological and other scientific groups.
4. Lectures on Science, Exploration and Travel by eminent men and women.
5. Popular Science lectures by local scientists.
6. Travel talks.
7. Courses in Field Biology in Summer Camps.
8. Library facilities.
9. Travel Information Bureau.
10. Garden Information Bureau.
11. Identification service—of specimens brought in by visitors.

The museum is an agency not only for the diffusion of knowledge but for its accumulation also, in virtue of the large collections of cultural value that it has in its vaults. The majority of American museums have extensive research programmes based on their collections. All the larger museums send out scientific expeditions every year to the remotest corners of the globe and the collections brought back are worked out by the museums' scientific staff and published as memoirs and bulletins. Researches are also sometimes carried out on such subjects as the effectiveness of displays, visitor comfort, etc., like the studies made by Professor Robinson of the Department of Psychology of the Yale University "to test, develop and improve techniques of serving groups of school children visiting the museum under guidance".

In order to hold educational lectures, concerts and entertainments, almost every museum has a fair sized auditorium. Some museums have a series of smaller lecture halls in addition. The auditorium is usually fitted with a stage, large enough to accommodate a full size symphony orchestra and is air-conditioned and acoustically corrected.

It seems hardly necessary to indicate that all these activities such as scientific expeditions, modern installations and educational programmes involve very heavy expenditure. Almost all the museums of the U.S.A. are supported both by the Government and the people. At the back of every museum there is an organisation which receives donations of various kinds from the public to finance its activities. Some museums are entirely supported by these organisations. The total membership of the American Museum of Natural History at the end of June 1947 was 34,398.

The museums of India present a very different spectacle. They are far behind the American Museums in exhibition, education and research. The only exception is the Natural History Section of the Prince of Wales Museum in Bombay, where the exhibition methods are on a par with those in America. They are well balanced by an active Research programme. The writer was gratified to hear in New York the name of its Research Journal, the *Journal of the Bombay Natural History Society* mentioned as the best of its kind in the world. Even this museum does not have any educational programme for childern or for adults. The museum is an agency with tremendous possibilities in educating the masses. There are nearly 2,000 museums in America to serve its population of 130,000,000. This works out to one museum for every 65,000 people. We in India, with a population of nearly 400,000,000 people (before partition) have only 100 museums or roughly one museum for every four million people. We should have at least 6,000 museums to reach this ratio.

So far as India is concerned, her contribution to the development of museums has not been appreciable. This is due to a variety of reasons, the foremost of which is that the museum is something exotic—a legacy which has been left her by the impact of Western Civilization. Not having flowered out of her own genius and not directly tied to the inte-

rests of the common man, she has not had much room for improvement. The word "museum" itself is derived from a Greek word meaning the abode of the Muses, or the Goddesses of Learning and the first museum in the world in Alexandria was founded in the 3rd century B.C. by the Macedonian General Ptolemey Soter, who became a Pharaoh. It was a real temple of knowledge where learned men from far and near came, studied and discussed various problems. Sculptures in stone, wood and metal paintings and even Natural History specimens were among the objects exhibited here. But this great museum died a natural death in the course of the next two centuries, mainly because its influence did not go below the level of the wealthy and influential class to the common man. Nearly 1,800 years were to elapse before the next museum was established in Germany by Conrad Gesner in 1598. His museum exhibited a large number of Natural History specimens and is considered to be the forerunner of the modern museum.

The second reason why the museum has not taken kindly to the Indian soil is due to a mistaken notion about the function of the museum. There is a fallacious belief, even among the intelligentsia of our country that the sole aim of a museum is recreation and not education. The primary function of a museum is education and the spreading of culture. Recreation is only incidental, although it is an element of great importance. Recreation is only a means to an end, where the end is education. Because of this attitude towards museums as purely recreational institutions, financial help from governments have always been meagre.

No museum that depends entirely on government for its support can make much headway with the limited funds allocated to them. Museums can never prosper, as exemplified by the great Alexandrian museum, if they do not fill a popular want and enjoy popular support. Unless the financial support of museums comes from the generous help of governments on the one hand and people on the other, there is no reasonable chance for them to prosper. The main reason for the stagnation of our museums is the niggardly support they get from governments.

1. The first step to take to improve our museums is to recognise the fact that museums have tremendous possibilities as agencies for educating the people. With this recognition, marked improvement in every direction is sure to result.

2. The present system of exhibition should be replaced by modern installations. The bulk of the collections should be put in reserve for the use of the serious student. A scheme for the teaching of a few worthwhile topics to the people should be prepared. Only those specimens from the reserve collections which are needed for the purpose be exhibited. The form of presentation should be simple, direct and dramatic to arrest the attention and hold the interest of the onlooker.

3. There should be temporary exhibitions of topical interest in a hall or halls specially provided for the purpose.

4. To supplement this exhibition programme there should be educational activities suited to the needs of our people young and old.

5. Museums should be more evenly distributed in India. There should be a National Museum in New Delhi and a Provincial Museum in every Province. Each Provincial Museum should have several branch museums, one for each town with more than five schools. There should not be more than one museum in any localilty, as they are apt to breed competition and the people are likely to pay only divided attention depending on the power exerted by any one museum. One of these branch museums should be a trailside museum consisting of a few acres of undisturbed forest land, to serve as a field station for the study of Wild Life.

6. The National Museum in New Delhi should have the following themes illustrated in its exhibition halls :—

(1) India in space—its position in relation to the world, the world to the solar system and the solar system to other systems.

(2) Our India: Illustration of its animal, plant, mineral and human resources—on the lines of Masani's "Our India".

(3) The Natural History of Delhi Province—Habitat groups.

(4) The Natural History of India—Habitat groups.

(5) Glimpses of the Animal life of the world.

(6) Glimpses of the Plant life of the world.

(7) Introduction to the Geology of the Earth.

(8) India in time: On the lines of the Discovery of India.

(9) World in time: On the lines of the *History of the World* by H. G. Wells.

(10) Art of Delhi Province—Art of India.

(11) Glimpses of World Art.

(12) Primitive Races of India and their Culture.

(13) Cultures of the different peoples of the world.

(14) The chief Industries of India including Agriculture.

(15) An introduction to everyday science.

(16) The Story of Health and its care.

Attached to the museum, there should be a Planetarium.

The Natural History, Art and History of the Province of Delhi should be represented in the reserve collections of the National Museum. In addition, collections of Art and History from all over India could also find a place. But as to the Natural History of India, only one or two groups of the animal kingdom, say Mammals or Birds, from all over India, need be kept here. Each of the Provincial Museums should concentrate similarly on some other group or groups from all over India. If this jurisdiction is not maintained, all the museums would compete with one another resulting in too much unnecessary destruction of life. If this plan is adopted, a specialist would know which museum he has to visit to study his particular speciality. Besides the necessity of maintaining reserve collections on the lines mentioned above, the National Museum has several other duties to perform, the most important of which are :—

1. To have collections from almost every corner of the globe, first from places with which it has direct contact and later from lesser known places. The National Museum of India should not merely be a collection of objects. It should also be a challenge to the artistic skill, technical ability, spirit of adventure, ingenuity and hardihood of India's sons. All these should find expression in this museum, which has to be the finest product of her culture. Her sons should sail the seven seas, scale the highest mountains and explore the wildest country to enrich the national collections.

2. To maintain a preparation department with initiative, courage and the resources to experiment and evolve the most effective methods of presentation. The results of such studies and techniques should be at the disposal of every museum in the country.

3. To undertake to train museum personnel in (*i*) the care and maintenance of collections ; (*ii*) cataloguing and registereding and other methods ; (*iii*) preservation of the varius classes of specimen ; (*iv*) prepartion and modern installation methods ; (*v*) Administration and (*vi*) Services.

4. Each of the Provincial Museums should endeavour to teach the common man something about himself and his environment. The Story of Health and everyday science should be compulsory sections, along with a small observatory and accessories.

5. Historic site museums and Park museums should be established wherever possible.

6. The Museums Associations of India be strengthened and a journal started.

The museum has been described as the ordinary man's university. A nation prospers only to the extent to which its common people prosper. So, the more universities of this kind, and more graduates from this university we have, the better it would be for our country.

N. G. Pillai.

"Gokulam,"
Nantencode,
Trivandrum,
*September* 28, 1948.

The writer was in the United States of America from May 12, 1947 to May 7, 1948, on deputation by the Government of Travancore to study museum methods in the country. He wishes to express his gratitude to the Travancore Government for making this opportunity available to him; and also to Mr. C. J. Hamlin, President of the International Council of Museums Dr. A. E. Parr, Director of the American Museum of Natural History, New York, Dr. L. V. Coleman, Secretary of the American Association of Museums, Washington, D. C., and to the Directors and staff of the various institutions he visited, without whose generous help his sojourn in the States would not have been as smooth and as profitable as it has been.

# NATIONAL RESEARCH PROFESSORSHIP OF INDIA

SIR C. V. RAMAN, KT., F.R.S., N.L.

WE wish to offer our heartiest felicitations to Sir C. V. Raman, Kt., F.R.S. N.L., on his appointment as the first National Research Professor in India, in recognition of his unique services in the cause of Science.

## STANDARDISATION IN INDUSTRY

IN the course of his Presidential Adress to the third meeting of the General Council of the Indian Standards Institution, the Hon'ble Dr. Syama Prasad Mookerjee declared, "The Government of India, by its declared Industrial Policy", "has undertaken definite responsibility for the development of certain sector of industries and has also postulated a definite pattern of control in respect of others. Consequently, certain inescapable responsibilities in respect of development of standards clearly fall on the Government. At the same time, the industry must also be prepared to play its part enthusiastically and efficiently."

"So far as present indications go, we have good reason to be hopeful of the future. Indian industry is gradually but steadily becoming conscious of the importance of standardisation. It is being increasingly felt that without the initiation of standards and quality control, our industry cannot survive the onslaught of foreign competition.

Industry is in fact already financing the Institution about three times the extent that was initially estimated by us. It is a natural expectation that as the ISI publishes a growing number of standards, the industry will more and more appreciate the services rendered by the Institution and will come to recognise it as their own organisation to serve their own interests. Possibly at some stage the ISI will be called upon to organise an enforcement branch as well, as is being done in Canada for example, in the case of elcetrical appliances. This will require not only greater co-operation of industry but also legislative support.

"I am glad to note that in the sphere of international organisation standardisation the ISI has now begun to take an active part. The report of the Director which has recently been circulated to you, indicates the scope and extent of this participation. With respect to special responsibilities of India as the Secretariat for two of the ISO Technical Committees, it may be noted that 9 member countries of ISO have agreed to be members of the Shellac Committee, while the ISO Secretariat Committee for Mica has drafted the scope of international work, which is now being circularised to all ISO Member countries. Ever since the cessation of hostilities in Europe, mica producing interests in India have been opposed to the introduction of standards in his most important commodity of international trade, which earns valuable dollar exchange for the country. It is therefore gratifying to note that Indian Mica Industry has now responded favourably to the need of the time."

## PRESERVATION OF PANCREAS-GLANDS WITHOUT REFRIGERATION

AT present, and possibly for many years to come the pancreas glands of slaughtered animals and of fish are the only source of insulin. During and after the war, insulin producers have had great difficulty in recovering their raw material, mainly because of the absence of appropriate refrigeration installations.

Unless the glands are processed without delay, or refrigerated at low temperatures (-20° to -30° C.,) their insulin content is rapidly lost. To find a means of preserving glands without refrigeration was therefore a problem of great importance.

After many unsuccessful experiments, a new process has been developed in the laboratories of the Farbwerke Höchst which answers these requirements.[1] This process is based on the principle of converting the pancreas-glands into a stable dry product by treating them with an anhydrous salt which binds their water content as water of crystallization. Anhydrous sodium sulphate is normally used for the purpose. As 142 grammes are required to bind 180 grammes of water, approximately 600 grammes of the salt are theoretically necessary to bind the water contained in 1 kilogramme of pancreas. In practice, however, 700 grammes are required. The dry preparation may be maintained at the degree of acidity required, for instance pH 5, by the addition of sodium hydrosulphate, tartaric acid, or any other suitable agent.

The idea of DEHYDRATING an organ in order to preserve it is not new.[2] But although the principle has already been applied by several workers to the preservation of pancreas[3], it has not so far yielded good results, mainly because these workers failed to recognize that it was essential that the glands should be disintegrated rapidly and thoroughly and treated with an anhydrous salt not after, but during, the disintegration. This process is most suitably performed in rapid cutting-machines of the type found in most butchers' shops.

The cutter consists of a rotating dish with a set of rapidly revolving sickleshaped knives which simultaneously perform the disintegration and mixing, the pancreatic tissue being cut and its surface immediately brought into contact with the salt. One of the advantages of this new method is that since it is simple and safe, it can be applied without special training by the personnel of slaughter-houses.

In a large cutter, 12 to 15 kilogrammes of glands can be processed at a time, and in the smaller cutters commonly found in butchers' shops, 8 to 10 kilogrammes. The glands should be collected and prepared as soon as possible after slaughtering, and then be kept in cold storage (5-8° C) until they are processed (not later than the same day). They are spread uniformally in the dish of the cutter and covered with 700 grammes of anhydrous, finely-ground sodium sulphate for each kilogramme of pancreas. The machine is then set in motion. After 8 to 10 minutes a homogeneous and rather compact mass is obtained and placed on iron sheets in a layer about 5 centimetres thick. The mass is then left for about one hour and taken into the refrigeration chamber for cold storage. By the next morning the cake will have solidified into slabs which are so hard and compact that they can be piled up without any special care.

If the batches are too large and processing is delayed, difficulties are likely to arise, because the mass solidifies too rapidly.

The preparation obtained must be stored in as dry place as possible at a temperature of 5-8° C. (cold storage). Under these conditions even after six months in storage, no loss of insulin occurs; even storage at normal room-temparature—provided that it does not rise to 30°C—is tolerated for several days without damage, which gradually facilitates transport.

Insulin is obtained from this preparation in the usual way, with the same yield as is usually obtained from frozen glands.[4]

By applying the process described above, the Farbwerke Höchst were able to double the number of slaughter-houses from which they obtain the necessary pancreas glands for the production of insulin. It may be said that the new method has so far stood every test and has done much to stave off the worst consequences of the insulin shortage for diabetics in Germany.

(*Courtsey of Chronicle of the World-Health Organisation*, July 1948, p. 153).

---

1. Application for German Patent No. 75315 IV a/30h filed on 21 June 1943. 2. See Frankel, in Abderhalden, *Handbuch der biologischen Arbeitsmethoden*, Hamburg, 1936-40, Sect. I. Part 6, p. 4. 3. See German Patent No. 441614 and British Patent No. 188660. 4. Some difficulties in centrifuging were experienced at the beginning owing to the salt content of the preparation.

## COMMERCIAL TIMBERS OF INDIA

TO bring to the notice of the public in these days of shortage of raw material, some more Indian timbers of great commercial potentialities, the Forest Research Institute, Dehra Dun, has published a brochure "Some More Commercial Timbers of India" in its new Utilisation Series. The publication deals with 28 timbers, some of which proved very suitable for various purposes during the last World War, when there was an unprecedented demand on the timber resources of India.

Before the War, the use of these timbers was restricted either because the forests in which they are grown were not easily accessible, or because their commercial possibilities had not been explored in peace time. The new publication gives a general idea of the possible uses of these timbers based on experiences gained during the war period particularly in four inrections: for general constructional work including carts and carriage building, for plywood packing cases and light furniture; for tools handles and for shuttles, toys and decorative articles.

# CYTOGENETIC CHANGES AND ATYPICAL GROWTH INDUCED BY HEXACHLOROCYCLOHEXANE ($C_6H_6Cl_6$)

DONTCHO KOSTOFF

*(Institute for Applied Biology and Organic Development, Academy of Sciences, Sofia, Bulgaria)*

SCIENTISTS occupied chiefly with applied science, especially such working in the fields of agronomy and medicine, often demanded with right, from the cytogeneticists, when they work on some theoretical problems to pay attention at the same time to the practical outcome of their studies giving sufficient theoretical background for elucidation of the methods adopted in the applied work. Having often heard such reproaches from various sides I have occasionally directed some of my studies to satisfy, as far as possible, some of the demands of the applied sciences. The results of such a recent study I have summarized and should like to report them. I shall mention here that the investigations are not yet completed in many respects but there are many points that deserve to be reported even at this stage of development.

The work of cytogeneticists and plant-breeders can often be methodically criticised when they treat material with certain insecticides or fungicides in order to protect their experimental material from parasites, but without considering the cytogenetic effect of chemicals applied in such cases.

The best insecticides and fungicides will be those which kill the plant parasites without affecting the plant organism. In fact they all affect more or less the host plant in various ways and degrees.[1,4] A series of fungicides and insecticides have similar effects on the plant organisms. Ethyl-mercury chloride ($CH_3CH_2HgCl$) for example, which is the active substance (2%) of the fungicide "Granosan", induces atypical growth, abnormal mitosis and polyploidy[3,4] reminding the effect of colchicine and acenaphthene.[5,6] Similar and at the same time very strong effect of this kind has hexachlorocyclohexane—another chlor-organic compound, recently recommended under various names. The insecticides "Agrocides", 7,3 etc., for example, the active substance of which is gamma isomer of 1,2,3,4,5,6-hexachlorocyclohexane, induce atypical growth suppressing the development of the roots, stems and coleoptyles of *Grammicious* plants, conditioning very striking thickening of these organs, especially of the growing points (roots, stems and coleoptyles).

Active insecticides, manufactured in various countries (hexachlorane, 666) and containing several isomers of hexachlorocyclohexane, including the gamma isomer, act in a similar, though not in an identical way. Hexachlorane, for example, stimulates the germination of certain *Cruciferæ* (*Brassica nigra*) and other plant seeds during the first two days of germination, so that they were even ahead in growth, when compared with the control samples and much ahead when compared with the germinating seeds treated with "Agrocide 7". But soon after this, the controls grow further, while the growth of the treated seedlings becomes strikingly suppressed. Some of the data of this material are given in Table I.

TABLE I

*Suppression of the growth by hexachlorane and agrocide 7. Length in mm.*

| | Germinating seed of | Untreated control in mm. | Treated with hexachlorane in mm. | Treated with Agrocide 7 in mm. |
|---|---|---|---|---|
| 1 | *Zea mays* (roots) .. | 22·03 | 12·07 | 8·90 |
| 2 | *Panicum miliaceum* (coleoptyles) | 10·00 | 4·76 | 3·32 |
| 3 | *Pisum orvense* (roots) .. | 23·21 | 9·62 | 7·73 |
| 4 | *Cannabis sativus* (stem and cotyledon) | 21·19 | 15·98 | 12·72 |
| 5 | *Brassica nigra* (stem and cotyledon) .. | 29·46 | 8·40 | 5·31 |
| 6 | *Secale cereale* (roots) .. | 20·46 | 2·65 | 1·33 |
| 7 | „ „ (coleoptyles) | 41·30 | 4·75 | 2·81 |

We have treated with insecticides containing hexachlorocyclohexane germinating seeds of the following plants: *Zea mays*, *Triticum vulgare*, *T. monococum*, *T. compactum*, *Secale cereale*, *Setaria italica*, *Panicum miliaceum*, *Helianthus annuus*, *Crepis capillaris*, *Vicia faba*, *V. sativa*, *Pisum sativum*, *Brassica nigra*, etc.

The cytological studies of the affected root, stem, and coleoptyle tissues show that the *agents act first of all upon the cytoplasm and interfere with the cytoplasmic processes* involved in the formation of achromatic figures. The chromosomes do not arrange in an equatorial (metaphasal) plate after prophase, but remain scattered approximately as they are during the prophase. They appear less bent than usually. The "thickening" of the chromosomes and their reproduction and splitting proceeds although the process involved in the formation of achromatic figures are highly disturbed or even entirely inhibited. The chromosomes thus reproduce, but remain where they are, without moving toward the poles. In fact, poles are not formed. After such a reproduction, the chromatolythic (nucleoproteolytic) processes proceed and nucleus is formed containing twice as many chromosomes as before the beginning of the abnormal mitotic processes. The main trend of the processes conditioning chromosome doubling resemble those induced by colchicine, acenaphthene and other polyploidizing agents.

Since the insecticides continue to act further, the next abnormal Ab-mitosis ends with second chromosome doubling and so on. Thus tetraploid and octoploid cells are formed and even cells of a much higher degree of polyploidy. Along with these, certain diploid cells, that have not yet undergone Ab-mitosis can be still found.

Chromosome multiplication leads to the increase of the size and occasionally of the number of the nuclei and further to the increase of the size of the cells. Thus the cells grow instead of multiplying and differentiating resulting in the swelling of the roots, stems and coleoptyles.

The chromosome reproduction and separation in *Zea mays* should be considered as a somewhat special case. We have observed in a series of cells that the chromatids of the somatic chromosomes are bent at the centromeres reciprocally to each other, each one, like V, thus both halves forming rather a X, the chromatids being attached at the centromere. These figures can be interpreted by postulating certain repulsion forces existing between the chromatids, the reproduction (rather the division) of the centromere, being somewhat delayed. This phenomenon occurs when the achromatic figure is highly or completely disturbed. In other words, it does not seem to be regulated to any extent by the forces evolved from the achromatic figure.

If we compare the polyploidizing potency of hexachlorocyclohexane with that of acenaphthene, we can with certainty affirm, that in *Gramineæ* the activity of both agents is approximately the same. Acenaphthene as polyiploidizing agent in leguminous plants, is not effective enough, while the activity of hexachlorocyclohexane is much more effective and we obtained in *Pisum* swellings resembling those induced by colchicine, as well as cells and tissues in *Vicia faba* having various degrees of polyploidy.

The solubility of hexachlorocyclohexane in water is very low, therefore, it is applied in the form of small solid particles. The particles act when they are in contact with the plant tissue. It has a specific smell, but the experiments failed, when it was tried to induce specific atypical growth from a distance. In this respect its effect differs from that of acenaphthene, the sublimating particles of which act from a distance even when the crystals are not in contact with the plant tissue. Floral buds of *Nicotiana tabacum* and raddish covered with hexachlorocyclohexane (mixture of various isomers), Agrocide 7, or hexachlorane showed none, or very few disturbances in the meiosis, as for example, occasional univalents and laggards or slight irregularities in the arrangement of the chromosomes in the equatorial plate, which probably may be due to a sequence of disturbances in the achromatic figure. Contrary to the very well expressed effect of acenaphthene upon meiosis in *Gramineæ* hexachlorocyclohexane does not affect, or its effect is quite insignificant upon meiosis in rye, when spikes were abundantly covered with Agrocide 7, Hexachlorane or mixture of isomers of hexachlorocyclohexane and inserted into test-tubes for 24 hours. Spikes of rye plunged into test-tubes with saturated solutions with some excesses of these substances, did not show significant effect, *i.e.*, significant disturbance in the meiotic processes. Similar experiments were carried out with tobacco and leguminous plants with similar results.

All these observations suggest that hexachlorocyclohexane acts upon the plant cells when its particles are in near contact with the tissue. The pollen mother cells, being protected, first of all, by the tissue of anther and then by the corolla and callyx tissues (or by the glumes in rye) are not effectively affected by the agent.

Experiments were also carried out with yeast in the following way: Sterile grape juice was inoculated with pure culture of yeast to some of the flasks Agrocide 7 was added, to others Hexachlorane and to yet others hexachlorocyclohexane (mixture of isomers). After 24 and 96 hrs. no striking changes in the size of the yeast cells were observed and when compared with the controls the fermentation in the treated cultures being somewhat suppressed and later completely inhibited.

Preliminary experiments were conducted with caterpillars of *Limantria dispar*, to study whether the agent acts upon the caterpillars first as polyploidizer, and the death being as a subsequent effect of it. But the observations, hitherto carried out, do not seem to support such supposition. The studies in this line are now continuing.

The effect of hexachlorocyclohexane upon the somatic tissues of the plants is so striking that it can be used as polyploidizing agent, especially when one considers the fact that it is much cheaper than other polyploidizing agents. We are now carrying out further experiments in this direction.

In studying the disturbances in the mitotic processes induced by hexachlorocyclohexane we have found that in certain cases chromosome group or groups may move slightly in some direction or directions into cytoplasm. Such a slight separation may occasionally end in the formation of two or more than two aneuploid nuclei. Thus polynucleate cells or cells with monstrously deformed nuclei appear. In certain cases between such nuclei, a cell wall is formed. This leads to formation of cells with aneuploid chromosome numbers. Dead cells were occasionally found in the roots, stems and in the coleoptyles. They may have been aneuploid.

All these phenomena leading to polyploidy or aneuploidy are due to the activity of the agent upon the cytoplasm.

But the active agent, *i.e.*, hexachlorocyclohexane also induces certain changes in the nuclear elements, *i.e.*, in the chromosomes, no matter how rare they may occur. Fragments of one chromatid or of chromosomes (both chromatids) were also observed, although very rarely.

Such insecticides or fungicides, when applied, may increase the hereditary changes in the cultivated "pure lines" leading thus to more rapid degeneration of the highly bred uniform varieties. This means that when one applies such insecticides or fungicides one should more frequently change the seeds of the varieties which he propagates, by using a fresh non-degenerated stocks.

Thanks are due to Dr. Manol Stoylov for help throughout this work.

1. Kostoff, D., "Degeneration of the Pure Lines," Sofia. 1930 2. —, *Bull. Soc. Bot. de Bulgarie*, 1931, **14**, 87-92. 3. —, *Nature*, London, 1939, **144**, 334. 4. —, *Phytopath. Zeitschr.*, 1940, **13**, 91-96. 5. —, *Compt. Rend.* (*Doklady*), *Acad. Sci. USSR.*, 1938, **19**, 189-92, 6. —, *Journ. Genet.*, 1940, **39**, 469-84.

# LETTERS TO THE EDITOR



## ELASTIC CONSTANTS OF SINGLE CRYSTALS OF BARIUM NITRATE

IN a recent note, now under publication in *Nature*, it has been reported from this laboratory that the photo-elastic behaviour of barium nitrate crystals is exceptional in many ways. It is considered desirable to obtain the elastic constants of these crystals as no such data are available in literature. Necessary sections have been prepared, and the following results obtained by employing the ultrasonic wedge method developed here.

$$C_{11} = 6 \cdot 02 \; ; \; C_{12} = 1 \cdot 86 \; ; \; C_{44} = 1 \cdot 21 \times 10^{11} \text{ dynes/cm.}^2$$

Plates of different thicknesses and wedges of different shapes have been used for confirmation in each case.

Dept. of Physics, Andhra University, Waltair, S. BHAGAVANTAM. R. V. G. SUNDARA RAO.
*October* 1, 1948.

## A REMARKABLE EVIDENCE OF A LOCAL THRUST PLANE AT THE TOP OF THE PURPLE SANDSTONE SERIES IN THE SALT RANGE

DURING our last excursion in November 1946, we came across an interesting thrust plane surface on the lower slope of the right (northern) ridge of the Gandhala gorge, S.W. of Choa Saidan Shah (Salt Range). The exact locality is where the foot-path called 'Majhi Chanewala rah,' running up along the outcrop of the Purple Sandstone from near the District Board Gardens in the gorge, passes between the two hills locally known as 'Jhangala and Othiawala'. As we climb up the spur along this foot-path and come to the top bed (a pebbly sandstone) of the Purple Sandstone series, we see a polished, more or less ridged and grooved, corrugated surface. This surface is over an area, about two yards wide and about seven yards long. It is likely to be mistaken at first sight for an artificially made surface, with drains having polished

cemented sides, the gritty conglomeratic stuff in the grooves suggesting as if the drains are filled with cement concrete (see the photo). The senior author was struck by its resemblance to the surface structures observed at places along the great Moine thrust plane in Scotland.

It may be mentioned in this connection that there runs a great thrust-fault along the foot of this spur which has brought the Kamlials in bottom of the valley against the Purple Sandstone of the spur, and that the Purple Sandstone is overlain by the Neobolus shales and other stratigraphical formations characteristic of the eastern part of the Salt Range.

According to Dr. Gee, pebbly bed at the top of the Purple Sandstone series is widespread and is a normal horizon of the series. We met Dr. Gee at Khewra at that time; and during two of his excursions, he showed us this pebbly bed in the Dandot gorge as well as in the Khewra gorge. The typical thrust plane structure seen by us at the above locality can, therefore, be only regarded as local. The Salt Range is now politically out of bounds to Indian geologists, but the Pakistan geologists can investigate this thrust plane in detail.

Dhanbad, N. L. SHARMA.
*September* 17, 1948. K. C. LAHIRI.

## THE HOME OF MONAZITE IN THE VIZAGAPATAM AREA

IN a recent paper,[1] the occurrence of monazite, zircon and other minerals in the beach sands of Vizagapatam was described. Subsequently, on a study of the origin of the Waltair Highlands by the authors of this note (under publication), the monazites were traced to the alluvium in the streams flowing down the hill ranges of this area. In order to fix definitely the home of this monazite, a very careful examination of the pegmatite veins which cut through the khondalites underlying the red loam of the Waltair Highlands was made. These pegmatites consist of grey, pink, and white felspars, white and bluish quartz, small books of biotite mica, opaque iron ore minerals, and some dark minerals with greenish tinge and sub metallic lustre. The pegmatites occur as lit-par-lit injections, veins, or sometimes as lenses and veinlets in the khondalites. Representative samples from four different pegmatites were pulverised and passed through 60-mesh sieve, and panned. In all the samples, the tailings show considerable quantities of monazite and zircon. The monazite is easily distinguished in the concentrates by its greenish yellow colour. The dark mineral with submetallic lustre occurring in the pegmatites was tested by physical and optical methods and identified as monazite.

Though granites occur in the vicinity of the khondalites as intrusives, the pegmatites do not show intrusive relationship with the granites. It is of interest to recall that Masillamani and Chacko[2] and also Masillamani[3] recorded the occurrence of monazite in pegmatites which are intrusive into the khondalites and charnockites in some areas in Travancore. Tipper[4] is of the opinion that the bulk of the monazite in the shore sands is derived from the gneisses of Travancore. Detailed investigations are in progress extending the enquiry to other areas and formations. The results of the investigations carried out so far show that in the Vizagapatam area, the pegmatites cutting through the khodalities carry the bulk of the monazite.

Department of Geology, C. MAHADEVAN.
Andhra University, N. SATHAPATHI.
Waltair,
*September* 28, 1948.

1. Mahadevan, C., and Sreeramadas, A., "Monazite in the beach sands of Vizagapatam District." *Proceedings of the Indian Academy of Sciences*, 1948, **27**, No. 4, Sec. A, 275–78. 2. Chacko, I. C., and Masillamani, E., "Report of the State Geologists, Travancore," 1907–1910 p. 7. 1910. 3. Masillamani, E, "A preliminary report on the geology of Eraniel, etc., Travancore," 1911, p. 6. 4. Tipper G. H., "The monazite sands of Travancore," *Rec. G.S.I.*, 1914, **44**, 94.

## INFLUENCE OF DIETARY FACTORS ON THE ENDOGENOUS CALCIUM EXCRETION IN THE ALBINO RAT

EVEN on a calcium-free diet, there is a small but distinct negative calcium balance as evidenced by the results of Jones.[1] The measurement of this endogenous calcium excretion is necessary while studying the availability of calcium. It is known that protein, fat and phosphorus in the diet influence the absorption and utilisation of calcium.[2, 3, 4] The effect of these dietary constitutents on the endogenous calcium excretion in the white rat forms the subject-matter of this note. These data would be of value in studying the physiological inter-relationships that exist in the metabolism of calcium on the one hand and these dietary factors on the other.

Six healthy adult rats were taken and their normal endogenous calcium excretion was measured for a period of one week. During this period they were fed on a diet adequate in all respects but free from calcium.* After keeping them on a normal stock diet for one week they were given three other diets which apart from

*(Values represent calcium excreted in mgm. for a period of one week)*

| Rat No. and sex | Calcium free diet | | | Calcium and protein free diet | | | Calcium and fat free diet | | | Calcium and phosphorus free diet | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Urinary | Faecal | Total | Urinary | Faecal | Total | Urinary | Faecal | Total | Urinary | Faecal | Total |
| 1 M .. | 6·3 | 23·6 | 29·9 | 5·3 | 29·9 | 35·2 | 7·8 | 38·7 | 46·5 | 9·7 | 38·8 | 48·5 |
| 2 M .. | 5·8 | 20·3 | 28·1 | 5·9 | 25·1 | 31·0 | 6·2 | 35·1 | 41·3 | 9·6 | 37·1 | 46·7 |
| 3 M .. | 7·5 | 25·1 | 32·6 | 7·2 | 30·4 | 37·6 | 8·6 | 39·8 | 48·4 | 10·2 | 86·5 | 49·7 |
| 4 M .. | 4·9 | 22·1 | 27·0 | 5·6 | 27·8 | 33·4 | 7·2 | 36·1 | 43·3 | 8·1 | 35·2 | 43·3 |
| 5 M .. | 5·6 | 25·6 | 31·2 | 5·6 | 20·2 | 34·0 | 6·7 | 37·2 | 43·9 | 6·5 | 32·7 | 39·2 |
| 6 M .. | 5·4 | 19·8 | 25·2 | 5·9 | 20·6 | 26·5 | 7·2 | 30·4 | 37·6 | 7·5 | 31·6 | 89·1 |
| Average | 5·9 | 22·8 | 28·7 | 5·9 | 27·2 | 33·1 | 7·3 | 36·2 | 43·5 | 8·6 | 35·3 | 43·5 |

being free from calcium were deficient in protein, fat and phosphorus respectively. Between successive experimental periods the rats were kept on the normal diet for one week. The calcium excretion of the rats on these diets was also measured.

Urinary calcium was measured according to the methods of Shol and Pedley.[5] Fæcal calcium was estimated by the method of McCrudden.[6] The data for calcium excretion of individual rats are given in the above table.

The effect of protein, fat and phosphorus on endogenous calcium excretion is evident from the above data. The absence of protein in the diet does not affect urinary calcium excretion. But fæcal calcium and the total endogenous excretion are slightly increased. The withdrawal of fat or protein increases both urinary and fæcal excretion. The fæcal calcium particularly is increased to a very large extent.

These results therefore show that under conditions of calcium deprivation or very low calcium intake, protein and phosphorus have a calcium sparing action. They also lend support to the fact that for efficient calcium utilisation, moderate amounts of protein fat and phosphorus are necessary in the diet. The increased urinary excretion is due to the withdrawal of calcium from the bones leading to an excretion through the renal channel. The origin of the increased fæcal excretion is not definite. Experiments are in progress to see whether this calcium has originated from the digestive juices or is due to the pouring in of calcium from the blood stream to the lumen of the gastro-intestinal tract as suggested by Steggarda, *et al.*[7]

H. S. R. DESIKACHAR.
V. SUBRAHMANYAN.

Department of Biochemistry,
Indian Institute of Science,
Bangalore.
*July* 25, 1948.

* The composition of the calcium free diet was. corn starch 51, cane sugar 20, cocoannt oil 10, casuin (freed from calcium according to Jones)15, and calcium free salt mixture 4. The diet was supplemented with vitamins A. D. and also the vitamins of the B complex group. The diet contained 6·2 mgs. calcium/100 gms.

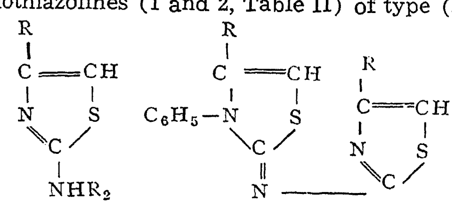
1. Jones, J. H., and N. E. Cohn., *Jour. Nut.*, 1936, **11**, 296. 2. McCance, R. A., Widdowson, E. M., and H. Lehmann., *Biochem. Jour.*, 1942, **36**, 686 3. Jones, J. H., *Jour. Nut.*, 1940, **20**, 367. 4. Bauer, W., Albright, F., and Aub., J. C., *Jour. Clin. Invest.*, 1929, **7**, 75. 5. Shol, A. T., and Pedley, F. C., *Jour. Biol. Chem.*, 1922, **50**, 537. 6. McCrudden, F. H., *Ibid.*, 1911–12, **10**, 187. 7. Steggarda, F. R., and Mitchell, H. H. *Jour. Nut.*, 1946, **31**, 423.

*Note.*—It is to be noted that the values for endogenous calcium excretion in the above cases are rather high being about twice as much as the figures reported by Jones. The traces of calcium present in the diet cannot however completely explain the rather higher calcium excretion in these cases.

## SOME NEW AMINOTHIAZOLES

THE discovery by Smirk and McGeorge[1] of the remarkable blood pressure raising property of S-methylthiourea sulphate and the discovery by Rose et al[2] of the promising local anæsthetic property of thiazole derivatives led us to the synthesis of a few new compounds of types (A) and (B) which could be considered as cyclised derivatives of both S-methylthiourea and of aminothiazole and hence would be possible pressor anæsthetics.

Following the known methods[3,4,5,6] compounds 1, 2, 3, and 4 (Table 1) were prepared by refluxing phenacylbromide with *m*-and-*p*-nitro as well as *o*-methoxy-phenythioureas and $\beta$-naphthyl thiourea respectively and isolating the products and purifying them from suitable solvent. The action of thiourea on 3 : 4 : 5—triacetoxy $\omega$-bromoacetophenone led to the formation of 4- (3′ : 4′ : 5′ triacetoxy)-phenyl-2-aminothiazole which was isolated as its hydrobromide 5 (Table I) the base being unstable. The reaction of phenyldithiobiuret with phenacyl-and $\beta$-napthacylbromides even when conducted in monomolecular proportions led to the formation of substituted 2-thiazolyl 2′-iminothiazolines (1 and 2, Table II) of type (B).



[R=$C_6H_5$; $\beta-C_{10}H_7$]

Type A Type B

TABLE I

| No. | $R_1$ | $R_2$ | m.p. °C. | Empirical formula | Nitrogen Per cent | |
|---|---|---|---|---|---|---|
| | | | | | Found | Calculated |
| 1 | $C_6H_5$– | $m$-$C_6H_4NO_2$ | 165 | $C_{15}H_{11}O_2N_3S$ | 14·1 | 14·1 |
| 2 | $C_6H_5$– | $p$-$C_6H_4NO_2$ | 202 | $C_{15}H_{11}O_2N_3S$ | 13·6 | 14·1 |
| 3 | $C_6H_5$– | $o$-$C_6H_4OCH_3$ | 195 | $C_{16}H_{14}ON_2S$ | 10·0 | 9·9 |
| 4 | $C_6H_5$– | $\beta$-$C_{10}H_7$ | 127 | $C_{19}H_{14}N_2S$ | 9·1 | 9·2 |
| 5 | 3 : 4 : 5-$(CH_3CO \cdot O)_3C_6H_2$– | H | 171 | $C_{15}H_{15}O_6N_2S$ Br | 6·5 | 6·5 |

TABLE II

| No. | $R_1$ | $R_2$ | m.p. °C. | Empirical formula | Nitrogen Percentage | |
|---|---|---|---|---|---|---|
| | | | | | Found | Calculated |
| 1 | $C_6H_5$ | | 227 | $C_{24}H_{17}N_3S_2$ | 10·2 | 10·2 |
| 2 | $\beta$-$C_{10}H_7$ | | 242 | $C_{32}H_{21}N_3S_2$ | 8·2 | 8·2 |

Org. Chem. Laboratories,
Bangalore.
Indian Institute of Science,
*September* 17, 1948.

M. V. BHATT.
B. H. IYER.
P. C. GUHA.

1. Smirk and McGeorge, *Lancet*, 1942, **243**, 301. 2. Rose, Shonle and Chen, *Pharm. Arch.*, 1940, **11**, 81-89. *Am. Chem. Abstracts.*, 1941, **35**, 1522. 3. Walther, *J. fur. Prakt. Chem.*, 1907, **87**, (ii) 187–199. *Chem. Abstracts*, 1907, **92 A**, 349–50. 4. Walther and Roch, *J. fur. rakt. Chem.* 1913, **87**, (ii), 27–66. 1913, *Chem. Abstracts*, 1913, **10'A**, 189–203. 5. Hantzsch and Traumann, *Ber.*, 1888, **21**, 938–941, *Chem. Abstracts*, 1888, **54A**, 573. 6. Traumann, *Annalen*, 1888, **249**, 31–53. *c.f. Chem. Abstracts*, 1889, **56A**, 414-15.

## A SIMPLE METHOD OF ISOLATING MUSTARD EMBRYOS AND THEIR CULTIVATION

IT was demonstrated by Gregory and Purvis, working with rye and Sen and Chakravarthi[2] with mustard that the seat of vernalisation changes is the embryo. The endosperm of rye and cotyledons of mustard do not play any part in the process.

This observation makes it clear, that for an understanding of the mechanism of vernalisation it is the embryo that should be subjected to critical study and for any progress the method of its isolation must be very simple and rapid, and that of its cultivation easy. The method decribed below for mustard satisfies these conditions.

A small sample of sun-dried large sized mustard seed is taken in a pestle and rubbed lightly with a mortar. Due to pressure the cotyledons break and the embryos get separated. With the help of a slanting piece of glass unsplit seeds are separated from the broken ones and again subjected to the process of rubbing. This could be repeated till there are very few seeds left. The preliminary separation of the embryos from the broken cotyledons could be done either by passing them through a sieve of appropriate mesh or by light winnowing. The final selection has got to be done by careful hand-picking and observing each apparently normal embryo under a dissecting microscope for any cleavage. These embryos could then be stored inside a desiccator for more than a month without losing their viability.

Out of the seeds of the different varieties tried it was found that yellow *sarson*, T. 102, on account of its thinner testa which is more or less loosely attached to the cotyledons, could be handled more easily than the others.

The embryos were first cultivated in a nutrient medium (Purvis modification of white's nutrient solution *plus* 2% sucrose)[3], but soon this method was discarded as they were found to grow directly on soil or even on filter paper soaked with tap water. The isolated embryos were sown in pots containing well manured finely sifted garden soil and watered from below by putting the pots in dishes containing water. The growth of the seedlings, however, was slow as ompared to those in the nutrient medium. The technique adopted and precautions taken are just similar to the raising of seedlings of small seeded plants like poppy, tobacco, etc.

An attempt to grow isolated embryos of wheat on the other hand, resulted in utter failure. No growth was observed in tap water until and unless the embroys were supplied with a small quantity of sucrose, while the mustard embryos grew well for some days even in glass distilled water.

This observation is interesting as the percentage of sucrose in the wheat (Pb 9-D) embryo-samples worked with was found to vary from 5·6 to 6·1% while it was absent in the embryos of mustard T. 102. Normally it is the mustard embryo that ought to have required sucrose for germination and not wheat. This presence of sucrose is also essential for the maximum vernalisation of rye embryos[3] but it is not so far the embryos of mustard[2] which, would germinate as well as vernalise quite successfully even in glass distilled water.

I have not so far come across a parallel case and would greatly appreciate if some workers could let me know cases of isolated embryos capable of germination and indepedent establishment in the absence of any nutrients.

It is my most pleasant duty to express my indebtedness to Mr. Boshi Sen, Director, Vivekananda Laboratory, Almora, for so kindly providing me the facilities for this work.

Department of Botany,
Balwant Rajput College,
Agra,
*October* 2nd, 1948.

S. C. CHAKRAVARTI.

1. Gregory, F. G., and Purvis, O. N., *Ann. Bot.*, 1938, **2**, 237. 2. Sen, B., and Chakravarti, S. C., *Natrue*, 1947, **159**, 783. 3. Purvis, O. N., *Ann. Bot.*, 1944, **8**, 285.

## THE EFFECT OF THE CULTIVATION OF BRASSICAE OIL-SEED CROPS ON THE SOIL FERTILITY

OIL-SEED crops occupy about 25 million acres annually in India (undivided) and the principal crops are groundnuts, linseed, brassicæ (mustard group), sesamum and castor. The groundnut and castor crops are practically confined to peninsular India, linseed is spread over the peninsular India and the Indo-Gangetic plain while brassicæ crops consisting of *torio, sarson* and *rai* are chiefly grown in the Indo-Gangetic alluvium with annual area of about 5·5 million acres. Sind, the fertile valley of the river Indus, has increased considerably the cropping area after the advent of the canal system which made the water available perennially. The substantial increase in area was expected to be under *rabi* cropping. The main *rabi* crops in Sind are wheat and the brassiacæ oil-seeds, besides gram and *lathyrus* which are either grown as second crop after rice or in the *katcha* lands (river inundation tracts). These brassicæ oil seed crops having a wide range of sowing form an important factor for the full and economic utilisation of the water under the irrigated conditions. The increase in area under these brassicæ crops has not been substantial mainly due to the general belief among the cultivators throughout India, though not substantiated, that the oil-yeilding crops are heavy feeders and exhaust the soil, adversely affecting the yield of the succeeding crop. Hence these crops are not usually included in the regular crop rotations. This greatly handicaps any attempt to increase the area under these oil-seed crops.

With a view to ascertaining the effect of cultivation of these oil-seed crops on the yield of the following crops, a series of field experiments were laid out at Dokri (Sind) during the years 1944-46. The data obtained from these experiments not only indicate the influence of the cultivation of oil-seed crops on the yield of the succeeding crop as compared with wheat but also furnishes the data for fixing the suitable rotation for the irrigated areas as the rotations are generally based upon the accumulated experience and results of the crop sequence experiments.

The experiments comprised of three sets. In each set the basic crops, *viz., torio, sarson* and wheat with fallow as the control were grown during the *rabi* season. Cotton, Jowar and wheat were grown on the same area in different sets as succeeding crops to gauge the exhausting effect of the previous crops on the soil during the year. Each set was a complete experiment laid out according to randomized block system with five replications, the ultimate size of the unit bed being 1/50th of an acre. The experiment was conducted for two years. The results are presented in the following table.

| Succeeding crop / Basic crop | Mean yield per acre in lbs. | | | | | |
|---|---|---|---|---|---|---|
| | Cotton (M4) | | Jowar (Soaro Kartuho) | | Wheat (At 38) | |
| | 1944-45 | 1945-46 | 1944-45 | 1945-46 | 1944-45 | 1945-46 |
| A—*Torio* .. | 1014 | 868 | 451 | 819 | 1221 | 1896 |
| B—*Sarson* .. | 1054 | 852 | 472 | 778 | 1346 | 1854 |
| C—Wheat .. | 768 | 675 | 335 | 560 | 1320 | 1620 |
| D—Fallow .. | 1580 | 1149 | 362 | 923 | 1554 | 1748 |
| F value .. | 12·96† | 3·49* | 2·47 | 2·70 | ·81 | 3·4 |
| Conclusions | D > A = B = C | D > A = B = C | .. | .. | .. | .. |

* Exceeds the 5% level of significance. † Exceeds the 1% level of significance.

From the above table it is evident that the yields of crops following the fallow are the highest and those after wheat are the lowest. However, the yield differences in case of jowar and wheat crops were not found to be statistically significant during both the seasons indicating that the growing of *torio* or *sarson* crop has no adverse effect on the yield of the subsequent crops. Another interesting fact is noticed that for shallow rooted crop like jowar or wheat previous fallow is not necessary. However in case of wheat crop the plots were lying fallow during the intervening *Kharif* season. In the case of cotton crop the yield differences were found to be statistically significant during both the seasons. It is evident that yield of cotton following the fallow is significantly higher while the yield differences between other treatments are not statistically significant. Thus the cultivation of oil-seeds in the previous season has no adverse effect on the yield of cotton as compared with wheat. It is however clear that cotton following fallow gives better response.

The above results conclusively prove that the brassicæ oil-seed crops have no adverse effect on the yield of succeeding crops and could be well included into a regular crop rotation.

M. V. VACHHANI.

Agric. Research Station,
Dokri (Sind),
*December* 12, 1947.
*Received September* 9, 1948.

## BREEDING OF *MUSCA NEBULO* F. FOR BIOLOGICAL TESTS OF INSECTICIDES

BIOLOGICAL tests of insecticides, either for standardisation or a study of reactions, require a pure bred healthy race of insects a continuous supply of which is assured by breeding. Grady[1] bred *Musca Domestica* L. throughout the year and Peet and Grady[4] used these flies for tests with insecticides. Hockenyos[2] reared flies for a similar purpose and Musham[3] reared *Musca vicina* Coq. The food used was chosen frequently because of its odour being attractive to flies and the adult flies of the required standard were those emerged out of pupæ which were segregated.

*Monthly data*

| Month | Average tempera-ture at 10 A.M. °C. | Average percentage Humidity | Average temperature for 24 hours | | Total No. of flies available for experiments for the month | Life-cycle days (average) |
|---|---|---|---|---|---|---|
| | | | Maximum °C. | Minimum °C. | | |
| June 1947 | 32 | 82 | 32 | 30 | 14301 | 13—19 |
| July ,, | 31 | 85 | 31 | 28 | 12883 | 15—23 |
| Aug. ,, | 31 | 83 | 29 | 28 | 10677 | 9—15 |
| Sept. ,, | 31 | 84 | 29 | 28 | 12476 | 9—14 |
| Oct. ,, | 30 | 77 | 30 | 28 | 9321 | 9—13 |
| Nov. ,, | 31 | 68 | 31 | 29 | 10786 | 9—13 |
| Dec. ,, | 31 | 65 | 29 | 28 | 12313 | 9—15 |
| Jan. 1948 | 28 | 68 | 28 | 27 | 12092 | 9—14 |
| Feb. ,, | 28 | 69 | 27 | 27 | 8576 | 9—13 |
| Mar- ,, | 30 | 68 | 30 | 28 | 9355 | 9—12 |
| April ,, | 31 | 74 | 31 | 27 | 8052 | 9—12 |
| May ,, | 31 | 74 | 32 | 28 | 10236 | 8—12 |
| June ,, | 31 | 78 | 31 | 27 | 16372 | 8—12 |
| July ,, | 30 | 85 | 30 | 29 | 13052 | 8—12 |

In the course of our studies in this laboratory during the past fourteen months the common Indian housefly *Musca nebulo* F. was bred continuously, the food adopted for rearing the flies being bran, banana, milk, glucose, vitamins D and E. Dishes with the eggs were kept in a specially designed cage where the entire life-cycle was completed. Adult flies were taken out of the cage and subjected to laboratory tests by means of specially designed apparatus.

The breeding was done entirely under laboratory conditions and the accompanying table shows the number of flies produced as well as other revelant details. The oviposition takes place after the fourth day of emrgence and the flies were used for tests on the fifth day.

Breeding took place in the light of an electric lamp. It has been observed that the egg-laying of the insects is affected by the different colours red, yellow and blue.

In tests with suitable insecticides these laboratory bred flies maintained a uniform standard of response under similar conditions. The female fly on an average is more resistant to insecticides than the male fly.

This method of breeding may be found useful in the genetical and cytological studies of these flies in particular and Diptera in general. Other details of some of our relevant work will be published elsewhere.

Biological Laboratories, P. J. DEORAS.
Geigy Insecticides Ltd.,
P.O. Box No. 756,
Bombay, 1.
October 2, 1948.

1. Grady, A. G., *J. econ. Ent.*, 1928, **21**, 598. 2. Hockenyos, G. L., *Ibid.*, 1941, **24**, 717. 3. Musham, B. F., *Bull. ent. Res.*, 1943, **35** (1), 53. 4. Peet, C. H., and Grady, A. G., *J. econ. Ent.*, 1928 **21**, 617.

## CARBOY AS A CHINESE WORD

FOWLER AND FOWLER, in their Concise Oxford Dictionary, refer to carboy as a "large coloured bottle protected with basket-work". It is further mentioned as a modification of the Persian word Qarabah. Hadi Hassan, in his "History of Persian Navigation", indicates contact between Persia and the Far East even earlier than Islam so that a word in Persian could have come through Pehlavi of Pre-Islamic Persia or *via* Arabic after that period. Either as an Iranian word or as a loan word previously adapted into Pehlavi it could not have incorporated the Arabic sound of Qaf. It is therefore natural to assume that Qarabah was acquired into Persian during its Post-Islamic period.

Just as Indians have made English their literary language Persians then often wrote and spoke in Arabic. Platts in his Urdu English Dictionary also states that Qaraba is a Persian word but one which has been derived from the Arabic root, "Qarb", having the meaning "to be near". I have shown elsewhere that a genuine word is always connotative, whereas, a typical loan word, whose origin is not known, is disposed off as genuine after having been attributed to it a far fetched meaning. That a root meaning "to be near" should give rise to a derivative meaning carboy is like meat to a gymnast in specialised reasoning but like poison to one depending mainly upon one's common sense. Further a Persian derivative has an Arabic root!

A more probable root for deriving Qaraba would have been the Arabic word "Qarba" meaning Massak or Skin as given in *J. Bombay B. R. Asiatic Soc.*, July 1847, p. 355. The word Massack is in common use in India for a leather bag for watering. However, there seems to be an even better explanation.

Giles, in his Chinese English Dictionary, gives character No. 2321 as Ch'iu meaning, among other synonyms, "a Globe". He gives a few terms compounded with it, one meaning "the terrestorial Globe" and another "Spherical". The most striking attribute of a carboy is not that it is made of glass but that it is a large globe. On account of its being placed in a basket its glassy nature is not very evident.

Character No. 7297 is Lo and means "Deep open basket without cover or handles ; crate". On looking at a carboy the basket serving as a crate is the more prominent. What we see is only a "*Globe* placed in a *Basket*", and precisely

these two features are expressed in a Chinese term for carboy.

A typical basket is always assumed to have a lid or a cover. The word "Lo" expresses an open basket, a Basket which is a crate. The Chinese use a term of two words since one of them alone may not serve its purpose in a monosyllabic language. An ideal synonym for Lo is character No. 9435 or P'o. This word is briefly translated in Mac Gillivray's Dictionary, p. 723, as a Basket-Tray, clearly indicating that the basket is an open one, more like a tray than like a basket with a lid or cover. Lo-P'o then signifies a deep basket which is quite open.

Doolittle, in his English Chinese Dictionary, Vol. I, translates a Great-Globe-of Glass, as To-Po-Li-Chiu, where Chiu is the word for Globe discussed above. The above term of four words cannot designate therein a carboy, for the latter is inseparable from its container, a Basket Crate, which is not expressed therein.

The term Ch'iu-Lo-P'o would appear to be the ideal term for carboy as it signifies a Globe placed in a deep Basket-Crate which is open, more like a tray than like a typical basket. This translation is condensed into Globe-Basket crate-Tray, to represent Ch'iu-Lo-P'o. Now this term in Cantonese is pronounced K'au-Lo-P'o. Like a copyist who thickens the delicate lines of an original drawing foreign sounds get emphasised in a loan word. There is a tendency to reproduce sounds clearer than those in the original; hence the resultant is an exaggeration of subtle syllables. The aspirated K sound has been accentuated into the sound of Qaf which is quite natural to Arabic, so that K' au could become Qau. L is regularly converted into R hence Lo becomes Ro. P'o is a foreign sound to Arabic: F wold be nearest to it but its next best conversion into B gives even a clearer sound than F. Cultured Persians speaking Arabic, who probably had to arabicise the term K'au-Lo-P'o, with a developed taste for euphony could not tolerate Qau-Ro-Bo so that the ultimate change gave the more pleasant modification Qa-Ra-Ba with all syllables ending in "A". An attempt to pronounce the last two terms would at once convince how the refined Persian was justified in having taken a little license with the original. Here we may compare the Korean modification of the same term, which is Ku-Ra-P'a. This is even nearer to the Perso-Arabic modification than to the Cantonese term K'au-Lo-P'o. It thus indirectly supports the modification of K' au-Lo-P'o into Qa-Ra-Ba.

*Summary.*—Carboy is supposed to be derived from Qaraba, which is a Persian word with an Arabic root, meaning "to be near". It is really a loan-word from the Cantonese term K'au-Lo-P'o meaning Globe-Basket crate-Tray. Persians with Arabic culture modified it having taken license for the sake of euphony, into Qa-Ra-Ba or Qaraba. As a loan word from the Chinese, Qaraba appears as a proper connotative word while as a Perso-Arabic word it bears a far fetched meaning.

Cipla Laboratories, S. MAHDIHASSAN.
289, Bellasis Road,
Bombay 8,
*October* 5, 1948.

## BIOLOGICAL CONTROL OF SOME HEMIPTEROUS INSECT PESTS OF CROPS IN INDIA

IN India there are several species of insects belonging to the families of Cicindelidæ and Coccinellidæ which are predators. Out of these two families of beetles, Coccinellidæ provides several species which are predaceous on aphids, psyllids and coccids. The insect pests belonging to this group of hemipterous insects cause very serious damage to Agricultural and Horticultural crops throughout India and it is necessary to explore the possibilities of controlling them through indigenous predators which are found in considerable numbers in the fields at the time of insect pest occurrence.

The following predaceous species of coccinellid beetles were collected at Kanpur during 1945-47.

1. *Coccinella sptempuctata* L.
2. *Coccinella sptempuctat* L. var. *divaricata*-Ol.
3. *Coccinella* 11 *punctata* var. *menetriesii* muls.
4. *Chilomenes sexmaculata* F.
5. *Chilomenes sexmaculata* F ab *inornata* Ws.
6. *Chilomenes sexmaculata* F ab *rufofasciata*.
7. *Chilomenes sexmaculata* F var. *undulata*.
8. *Brumus saturalis* F.
9. *Verania cardoni* Ws.
10. *Chilocorus nigritus* F.
11. *Chilocorus circumdatus* F.
12. *Sumnius renardi* Ws.
13. *Sumnius cardoni* Ws.
14. *Scymnus nubilus* Muls.
15. *Scymnus* sp.
16. *Rodolia fumida* Muls.
17. *Rodolia* sp.
18. *Thea cincta* F.
19. *Sticholotis* sp.
20. *Synia melanaria* ab *rougeti* Muls.

Out of the above 20 species collected at Kanpur, the species number 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 14 are very common and are found feeding year after year on aphids, citrus psylla, mango mealy bugs and mango scale. It has been observed that mustard, jowar or maize aphids, citrus psylla, mango mealy bugs and mango scale (*Pulvinaria* sp.) cause serious damage once in every five years or often even more. The population of these insect pests increases in the fields and the natural control is brought about by these beetles to a very great extent.

On the basis of these field observations, experiments were laid out under laboratory conditions to find out the degree of mortality caused by the grubs and adults of the predaceous coccinellid beetles. The following table gives percentage of host insects eaten by one grub and one adult and the maximum fecundity of seven species.

The percentages given are for one grub and one adult for comparison.

It will be observed from the above table that each of these beetles destroys a fairly high percentage of pests. *Sumnius renardi* Ws. destroys a large number of the early stages of mango mealy bugs. In 1946-47 the whole mango tree was covered with the grubs and adults of this beetle and had brought about considerable mor-

*Percentage of mortality caused by some common Indian Coccinellidæ*

| Name of the predator | % Destroyed by | | | Fecundity | | Days | | | Host |
|---|---|---|---|---|---|---|---|---|---|
| | Grub | Adult | Average | Max. | Average | Grub | Adult | Average | |
| *Coccinella septempunctata* L. | 84 | 73·6 | 78·8 | 562 | 395 | 13 | 36 | 24·5 | Aphis |
| *Chilomenes sexmaculata* F. | 88·3 | 86·1 | 87·2 | 632 | 373 | 9 | 28 | 18·5 | do |
| *Brumus saturalis* F. | 91·8 | 79·9 | 85·85 | I14 | 105 | 12 | 23 | 17·5 | do |
| *Coccinella* 11 *punctata* L. | 95·7 | 87·0 | 91·35 | 450 | 322 | 14 | 33 | 23·5 | do |
| *Coccinella* 11 *punctata* var. *menetriesii* Muls. | .. | 92·1 | .. | .. | .. | .. | 31 | .. | do |
| *Verania cardoni* Ws | .. | 89·7 | .. | 350 | 181 | .. | 28 | .. | do |
| Average .. | 89·95 | 84·73 | 85·8 | 421·6 | 275·2 | 12 | 29·83 | 21 | |
| *Chilomenes sexmaculata* F. | 83·8 | 90·3 | 86·5 | .. | .. | 9 | 35 | 22 | Psyll a |
| *Brumus saturalis* F. | .. | 91·9 | .. | .. | .. | .. | 25 | .. | White fly |
| *Sumnius renardi* Ws. | 77·2 | 64·4 | 70·8 | 420 | 298 | 22 | 61 | 41·5 | Mango mealy bug. |

tality of the mango mealy bugs. *Chilocorus nigretus* F. was also observed to feed extensively on the mango scale (*Pulvinaria* sp.).

The mortality of aphids caused by the several species of coccinellid beetles, individually and collectively, is encouraging. The maximum fecundity and average fecundity of these beetles is satisfactory. The period during which mortality was caused by the grubs and adults is fairly long and they were active throughout the year. Thus above quantitative data indicates the potentiality of these predators in the control of these pests provided they are used under known biological conditions.

Mass rearing under controlled conditions and their liberation in the infested fields, on the lines of Los Angeles Laboratory, U.S.A. for *Cryptolœmus* and *Rodolia* may thus provide an ample opportunity to the applied Entomologists for using biological control on some of the hemipterous insect pests of crops in India by indigenous Coccinellidæ.

U. S. Sharga.

Agricultural College,
Kanpur,
*September* 7, 1948.

1. Aiyer, T. V. R., *Jour. Bomb. Nat. Hist. Soc.*, 1925, **30.** 2. Beeson, C. F. C., *Forest Insects of India*. 1941. 3. Fletcher, T. B., *Some South Indian Insects.*, 1914, 4. —, *Agr. Inst. Pusa Bull.*, 1916, 1919. 59 and 89. 5. Kapoor, A. P., *Ind. Jour. Ent.*, 1939, **1.** 6. —, *Curr. Sci.*, 1940, **9.** 7. —, *Ind. Juor. Ent.*, 1942, **5,** 8. Trehan, K. N., *Curr. Sci.*, 1943, **12,** 9. Trehan, K. N., and Bagal, S. R., *Jour. Bomb. Nat. Hist. Soc.*, 1945, **45,** 4. 10. Varma, B. K., *Thesis M. Sc.* (*Ag.*) *Agra University Lib.*, 1947.

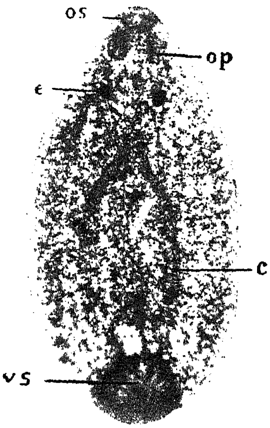
## ON A NEW CERCARIA, DETERMINED TO BE THE LARVA OF *GASTRODISCUS SECUNDUS* LOOSS, *1907*

During the course of a systematic study on the cercarial fauna of fresh-water molluscs in Madras, a type of Amphistome cercaria was met with, which differed considerably from the known species of the group. Transmission experiments revealed that this is the larva of *Gastrodiscus secundus* Looss, 1907.

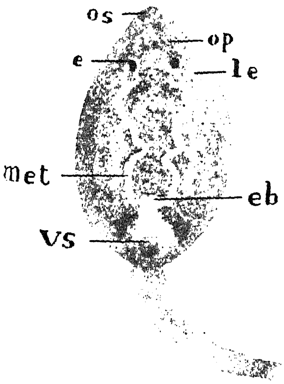
This cercaria was obtained exclusively from *Planorbis exustus* Deshayes. Its general behaviour and morphological features are very much in conformity with those of the other Amphistome cercariæ, excepting for the deviations mentioned below. It presents all the characters described for the subgroup "Diplocotylea" of Sewell (1922). Only two forms belonging to this subgroup—*Cercariœ Indicœ XXI* Sewell (1922) and *Cercaria kylasami* Rao (1932)—have been previously reported from India.

The present one can be differentiated from the two forms mentioned above by the following features :

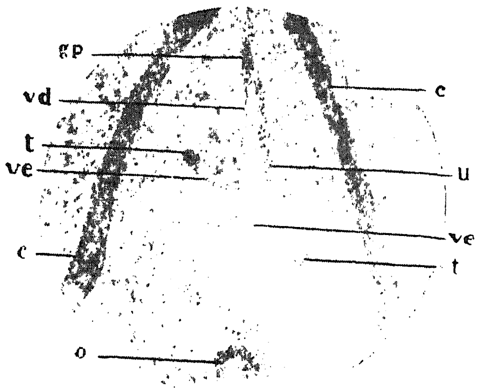
1. The presence of two well-defined oral pouches (pl. 1),
2. The occurrence of yellowish-brown, rectangular, crystalline contents in the œsophagus and the cæca,
3. The less tortuous course of the main excretory trunks (pl. 2) which are provided with lateral evaginations, anteriorly,
4. The typical picture afforded by the different cell groups of the genital system (pl. 3) which are arranged exactly similar to the reproductive organs in the adults of the genus *Gastrodiscus*.




Pl 1.




Pl 2.




Pl 3.

5. The excretory granules in the retrograde continuation of the main excretory canals, and the floating intestinal glands with their ducts and atrium described for *Cercaria kylasami* are lacking in this cercaria under study.

These cercariæ develop in sausage-shaped rediæ, infesting the digestive gland of the molluscan host. The rediæ have almost the same morphological features as described for the other Amphistome redial stages. But it differs from those of the other Indian members of the "Diplocotylea" group in the presence of dark, irregular pigmentary patches on the body-wall in larger specimens only, the absence of ambulatory processes and gut contents, and in the existence of distinct excretory bladders. The rediæ are found to give rise to daughter rediæ or cercariæ or both.

The cercariæ and their parthenitæ raised experimentally in the laboratory, by infecting *Planorbis exustus* with miracidia from the eggs of *Gastrodiscus secundus*, are exactly identical in every detail to those discharged by the snails that had the natural infestation with this type.

Further, adult specimens of *Gastrodiscus secundus* were recovered from the experimental donkey-foal, fed with the newly obtained cercariæ—a fact, which establishes that the cercaria under study is the larva of *Gastrodiscus secundus*.

A detailed study of the different aspects of both the pre-cercarial and the post-cercarial stages in the development of *Gastrodiscus secundus* is in progress.

*Summary.*—A new cercaria has been described belonging to the Amphistome group and this has been established to be the larval form of *Gastrodiscus secundus*, by feeding experiments.

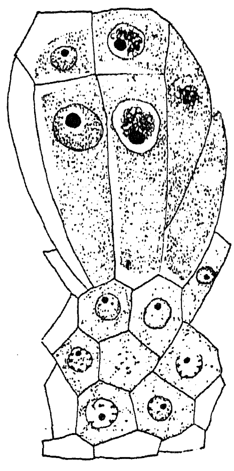
Department of Parasitology, Madras Veterinary College,
C. T. PETER.
S. V. MUDALIAR.
*September* 1, 1948.

1. Rao, M. A. N., *Cercaria kylasami* sp. nov. *Ind. Jour. Vet. Sci. & Ani. Husb.*, 1932, **2**, (3) 259–61.
2. Sewell, R. B. S, "*Cercariæ Indicæ*," *Ind. Jour. Med. Res.*, 1922, **10**, (Supplement) 1–370.

## DEVELOPMENT OF EMBRYO-SAC IN SOME STERCULIACEAE

OUR knowledge of the development of the embryo-sac in the Indian representatives of Sterculiaceæ is meagre (Y. M. L. Sharma, 1938 and I. Banerji, 1941). The present communication embodies some interesting features in the structure and development of the ovule and embryo-sac in five species of Sterculiaceæ, *viz.*, *Pterospermum Heyneanum* Wall, *P. acerifolium* Willd, *Klienhovia hospita* Linn., *Waltheria indica* L., and *Sterculia alata*.

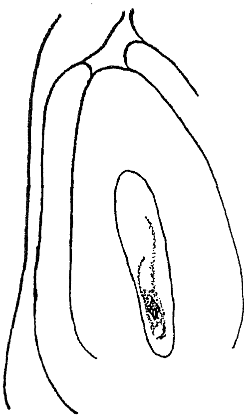
*Pterospermum* species differ from other plants studied in having a multicellular archesporium. A group of 10-15 cells extending to two or three layers below the epidermis of the ovule function as archesporial cells; the hypodermal cells cut off primary parietal cells which give rise to a considerable parietal tissue while the sub-hypodermal cells function directly as the megaspore mother cells. Usually a few tetrads are formed in each ovule. A group of cells immediately below the archesporium in the central region of the ovule differ from the rest of the nucellus cells in being larger, having thinner walls, larger nuclei and vacuolated cytoplasm (Fig. 1). The lowest megaspores of the tetrads



(FIG. 1)

become much elongated and taper towards the cell complex mentioned, probably deriving nourishment from it. Ultimately these cells are crushed by the developing embryo-sac or sacs.

In the one-nucleate stage of the embryo-sac it is seen that the chalazal end elongates into a tubular haustorial process. The nucleus and most of the cytoplasm migrate into it. Usually the nucleus divides in this position (Fig. 2). An



(FIG. 2)

8-nucleate embryo-sac is formed after three successive free nuclear divisions. The antipodals degenrate early. Two or three embryo-sacs are formed in some ovules, a fact noted by Sharma also previously.

In the rest of the plants studied, the archesporium is 1-celled although occasionally two archesporial cells and even two 2-nucleate embryo-sacs in each ovule have been observed in *Klienhovia hospita.* Usually the chalazal most megaspore of the tetrad is functional in these plants but in a few cases of *Klienhovia* and *Waltheria,* the one above the chalazal most is seen to develop further.

In *Pterospermum* species and *Klienhovia hospita* the antipodal end of the embryo-sac remains tubular owing to the presence of a jacket of thick walled cells around it. A hypostase is formed in the basal part of the ovule in *Waltheria indica.*

A fuller account of the floral anatomy, microsporogenesis, and embryo-sac development will appear elsewhere.

C. VENKATA RAO.

Department of Botany,
Andhra University,
Waltair.
*September* 12, 1948.

1. Sharma, Y. M. L., "A note on gametogenesis in a few members of Sterculiaceæ," *Curr. Sci.*, 1930. **7,** 284–85. 2. Banerji, I., "A note on the development of the female gametophyte in *Abroma augusta* L. and *Pentapetes phoenicia* L.," *Curr. Sci.*, 1941, **10,** 30.

## SPHINCTERED APERTURES IN THE INTERSEGMENTAL SEPTA OF EARTHWORMS

IN 1919 Bahl,[1] in the first of his remakable series of papers describing the enteronephric type of nephridial system in earthworms of the family Megascolicidæ, also described *sphinctered apertures* on the intersegmental septa of the three species of *Pheretima.* These apertures have not been found in any other earthworm and in 1930 Stephenson[2] rightly remarked that, "So far as known, they are confined to genus *Pheretima.*" Recently on examining two species of the genus *Drawida* (*D. ghatensis,* and *D. travancorensis*), sphinctered apertures have been found to occur in these earthworms as well, but that their situation is a little different. The septa of this worm are muscular and complete with no apertures on them at all, but there is a thin membrane, connecting the middle of the posterior face of each septum with the muscular bladder of the nephridium lying immediately behind it. It is this connecting membrane which is riddled with sphinctered apertures. I have counted the number of these apertures on *eight* such membranes and find that the average number is 200 on each membrane. The diameter of the apertures is, on an average, $57\,\mu$, while the average thickness of the sphincter is $15\,\mu$.

In discussing the possible function of these sphinctered apertures on the membranous septa of *Pheretima,* Bhal[1] wrote, "The sphincter muscles round the apertures are *a priori* the means of closing these apertures and thus restricting the flow of the cœlomic fluid to particular segmental chambers ............ which leads to a condition of turgidity of these segments and thus makes them stiff for the leverage of setæ." In case of *Drawida* apparently this explanation will not hold good, as the sphinctered apertures here do not lie on the main body of the septum, but only on a subsidiary membrane connecting the nephridium with the septum. There is little doubt that this subsidiary membrane supports and keeps the bladder of the nephridium in position. It is possible that the apertures minimise the chances of the membrane preventing a free flow of the cœlomic fluid within each segment.

I am thankful to Prof. K. N. Bahl for reading through this note and to Miss S. Mathew and Mr. P. V. Kurian for collecting the two species of *Drawida* from Travancore.

VIDYA VATI.

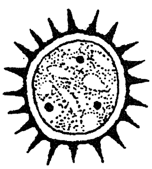
University of Lucknow,
*September* 15, 1948.

1. Bahl, K. N., *Quart. Journ. Micr. Sci.*, 1919, **64,** Pt. 1. 2. Stephenson, J. *The Oligochæta*, 1930, Oxford.

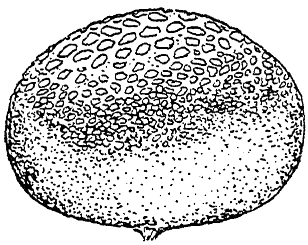
## A TRUFFLE (*TUBER SP.*) FROM KODAIKANAL HILLS (MADRAS)

TRUFFLES are highly prized in Europe as a delicate article of food, they are found in California also; fruit-bodies of trufles are dug up underground because they normally grow 3-12 inches below the surface of the soil; they emit a characteristic odour and are located by the aid

of specially trained dogs and pigs, whose keen scent enables them to spot these underground fruit-bodies right. The particular odour is not evident to most human beings. *Tuber* species occur commonly in deciduous forests of North Italy, France, Germany and other places in Europe. The mycelium of some species of Tuber has been recorded in France by late Prof. P. A. Dangeard in 1894[2] as a mycorrhizal symbiont with roots of various trees, especially oaks and beeches and some conifers; other species are true saprophytes. Truffles come under Ascomycetes—Tuberales—the genus being *Tuber*. The ascocarp remains closed after it is mature and the ascospores are liberated only after the decay of the outer covering. Spore-disposal is effected through the agency of animals, especially rodents. In California, some of the Tuberales are a favourite food of wood rats[4] which detect them by their very characteristic smell. The fruit-bodies (ascocarps) dug up by the rats may be eaten on the spot or carried to their dens; in either case, pieces falling on the ground, usually inoculate the soil. Ascospores may also be distributed as undigested spores passing through the alimentary canal of the animal that has swallowed an ascocarp.[3]



Ascospores



Ascocarp

Last month I received some specimens of truffles through the kindness of Dr. Mukherjee, Director of the Central Drugs Laboratory, Calcutta, collected from Kodaikanal hills (Madras) by Mr. C. G. Hylten Cavallius of the Western India Match Co. Ltd., in June and July 1948. The ascocarp is about 4 cm. long and oval-shaped with warty scales on the outer surface; ascospores are brownish, globose with diameter 10-12 $\mu$ spore-wall distinctly spiny, ascospores (2-4) enclosed within clavate thin walled asci. This *Tuber* sp. is a rare find for India. There is only one previous record of truffle from India, *Tuber indicum* Cke, and Massee in "Himalayan Truffle, 1892" listed in 'Fungi of India' by Butler and Bisby[1], it was collected by Duthie in Mussoorie hills.

Botanical Laboratory, S. R. Bose.
Carmichael Medical College,
Calcutta,
*September* 15, 1948.

1. Butler and Bisby, *Fungi of India*, 1931. 2. Dangeard, P. A., *Le Botaniste*, 1894, **4**, 61–87. 3. Massee, G., *Ann. Bot.*, 1909, **23**, 243–63. 4. Parks, H. E., *Micologia*, 1919, **11**, 10–21.

## ACTIVE ELONGATION OF UNSTRIATED MUSCLE

Relaxation of striated muscle is known to be active; see Ramsey (1947) for references. Singh (1944), Singh and Singh (1946), Singh, Singh and Muthana (1947) have described active elongation of unstriated muscle. These experiments, however, were not satisfactory owing either to abnormal stimulus or abnormal saline used. Satisfactory evidence of active elongation during relaxation has now been obtained. Pieces of dog's stomach, if carefully dissected relax actively when stimulated with alternating current (12 volts for 10 seconds). The results are shown in Table I. The muscle was laid in a trough and stimulated isotonically. If the dissection is not good, then the pieces curl or twist and it is then difficult to follow relaxation.

| Experiments No. | Resting length of muscle; mm. | Length during contraction mm. | Length after Relaxation mm. |
|---|---|---|---|
| 1 | 55 | 24 (43, p.c.) | 35 (63, p.c.) |
| 2 | 65 | 40 (61, p.c.) | 65 (100, p.c.) |
| 3 | 60 | 32 (53, p.c.) | 54 (90, p.c.) |
| 4 | 39 | 35 (89, p.c.) | 41 (105, p.c.) |
| 5 | 55 | 31 (56, p.c.) | 46 (83, p.c.) |
| 6 | 66 | 42 (63, p.c.) | 59 (89, p.c.) |
| 7 | 65 | 34 (52, p.c.) | 63 (97, p.c.) |
| 8 | 65 | 43 (66, p.c.) | 62 (95, p.c.) |
| 9 | 52 | 30 (57, p.c.) | 50 (96, p.c.) |
| 10 | 30 | 20 (66, p.c.) | 32 (106, p.c.) |

It will be seen from the table that the relaxation is complete in many muscles. Active relaxation is antagonised by substances that produce tonic contraction, such as excess of lithium, ammonium, potassium, calcium, strontium, barium, bromide, nitrate, iodide, thiocyanate, cyanide, acetylcholine, iodoacetic acid. It is less evident if a strong stimulus is used (50 volts), or if the muscle is asphyxiated or after soaking in saline for about an hour, a procedure which increases tone.

Tonic contraction is then due to interference with active relaxation, in agreement with views recently published (Singh and Singh, 1948).

Physiological Laboratory, Inderjit Singh.
Medical College, Sunita Inderjit Singh.
Agra,
*September* 22, 1948.

1. Ramsey, R. W., *Ann. N. Y. Acad. Sci.*, 1947, **47**, 675. Singh, I., *Curr. Sci.*, 1944, **13**, **311**. Singh, I., and Singh, I., *Proc. Ind. Acad. Sci.*, 1946, **23**, **312**. 1948, **27**, 127. Singh, I. Singh, I., and Muthana, M. C., *Proc. Ind. Acad. Sci.*, 1947, **25**, 51.

# REVIEWS

**Astronomy** By William T. Skilling and Robert S. Richardson. (Revised edition. Chapman & Hall Ltd., London), 1947. Pp. xii + 692. Price 28 *sh.*

Astronomy has a special fascination for all educated people, whether trained in the natural sciences or in the humanities. A good book on astronomy can therefore be expected to interest a large circle of readers of one kind or another; but it is not often that one comes across a book on astronomy which is of universal appeal. Skilling and Richardson's *Astronomy* is one of those rare books whose style and breadth of scope will satisfy almost everyone who is interested in knowledge for its own sake and who has stared up at the stars and felt a thrill of awe in the face of mystery and eternity. The first edition (1939) of the book filled the gap which existed between the entirely popular accounts of astronomy like some of the writings of Eddington and Jeans, which made the average man marvel at the astounding achivements of the human intellect in this branch of science, and the highly mathematical and sometimes abstruse books by the same great astronomers and many others, which are intelligible only to the professional astronomer or mathematical physicist. The revised edition (1947) of Skilling and Richardson's book is therefore sure of a welcome from layman and professional alike.

Although the book appears to be planned primarily as a text-book for American college students, its scope is vast,—that is the only adjective which suits. It is divided into three parts under broad headings. Part I is headed "The Earth and the Moon in Astronomy"; it deals not only with the earth and the moon, but also in a general way with the other members of the solar system and even with the essential principles of construction and use of telescopes, spectroscopes and various other instrumental equipment of the astronomer. A more detailed account of the sun and the planets (other than the earth) and their physical constitution comes under Part II which is headed "The Physical Nature of the Sun and Planets". Again the subject-matter of this part is much more comprehensive than the necessarily short title implies; for, in this part, the authors have wisely included a very simple, but quite effective, summary of the basic properties of light, of the ordinary and the radioactive atoms as well as an outline of the modern theories of the origin of spectra, without which the lay reader would be unable to appreciate the results of the study of the physics of the sun and the planets here described. To many readers,—at any rate to the present reviewer—, the highlight of the book would however be Part III, whose title is "The Stars and Nebulæ". Here we have a concise and yet very readable account of the fundamental facts so far discovered, as well as of some of the fascinating theories or speculations concerning the most distant components of the universe.

As I have already said, the scope of the book is vast. This vastness of range is at once the merit and the weakness of the book. The authors have made a praiseworthy attempt to include in a single, essentially descriptive volume practically all important known facts and theories of astronomy. This is humanly impossible to achieve, and the inevitable result has been a certain degree of sketchiness in the treatment of some matters, and some subjects have received inadequate attention notwithstanding their undoubted interest and importance. To mention a few, one would have liked to have a fuller description of the theories of cepheid variation, of the interior of stars, of interstellar matter, of the magnetic fields of stars, etc. Though the book is written in a semi-technical, descriptive style, the authors have achieved a remarkable measure of success in maintaining a high standard of accuracy in the statement of scientific facts. But a few loose statements, though of minor importance, have crept in; for instance, it is not strictly accurate to say that "They (*i.e.*, monochromators developed by Öhman and others) do optically what the spectroheliograph does mechanically" (*vide* p. 167). Again, from the last sentence on p. 364 one gets the impression that prominences projected on the disk of the sun generally appear "as long, dark plume-like markings roughly parallel to the solar equator"; but the fact is that the dark markings definitely show a progressive increase of inclination to the meridians from the equator to the poles, the inclination to the meridians being, on the average, zero at the equator and 90° at the poles.

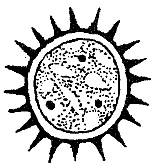
The book is very well illustrated and has a number of instructive tables and charts, as well as an Appendix which includes a glossary of technical terms used in the text and a list of astronomical and physical constants. It is, I believe, the most up-to-date and informative book on descriptive astronomy that is available at the present moment. The authors, one of whom is a retired college professor and the other an active researcher at the most modern and powerfully equipped observatory in the world, deserve all praise for their planning and writing of this excellent book in which answers in simple language to an amazing number of cosmic problems will be found.

A. K. DAS.

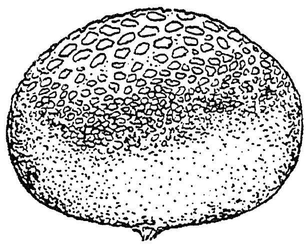
**Fundamental Principles of Ionospheric Transmission Radio Research Special Report No. 17 of the Department of Scientific and Industrial Research and Admiralty. Published by H. M. Stationery Office, London. Pp. 82, Price 1s 6*d*. net.**

*This booklet was issued during the War to the Services to interpret the results of observations of the conditions in the Ionosphere into instructions for procedure in operating the complex*

of specially trained dogs and pigs, whose keen scent enables them to spot these underground fruit-bodies right. The particular odour is not evident to most human beings. *Tuber* species occur commonly in deciduous forests of North Italy, France, Germany and other places in Europe. The mycelium of some species of Tuber has been recorded in France by late Prof. P. A. Dangeard in 1894[2] as a mycorrhizal symbiont with roots of various trees, especially oaks and beeches and some conifers; other species are true saprophytes. Truffles come under Ascomycetes—Tuberales—the genus being *Tuber*. The ascocarp remains closed after it is mature and the ascospores are liberated only after the decay of the outer covering. Spore-disposal is effected through the agency of animals, especially rodents. In California, some of the Tuberales are a favourite food of wood rats[4] which detect them by their very characteristic smell. The fruit-bodies (ascocarps) dug up by the rats may be eaten on the spot or carried to their dens; in either case, pieces falling on the ground, usually inoculate the soil. Ascospores may also be distributed as undigested spores passing through the alimentary canal of the animal that has swallowed an ascocarp.[3]



Ascospores



Ascocarp

Last month I received some specimens of truffles through the kindness of Dr. Mukherjee, Director of the Central Drugs Laboratory, Calcutta, collected from Kodaikanal hills (Madras) by Mr. C. G. Hylten Cavallius of the Western India Match Co. Ltd., in June and July 1948. The ascocarp is about 4 cm. long and oval-shaped with warty scales on the outer surface; ascospores are brownish, globose with diameter 10-12 $\mu$ spore-wall distinctly spiny, ascospores (2-4) enclosed within clavate thin walled asci. This *Tuber* sp. is a rare find for India. There is only one previous record of truffle from India, *Tuber indicum* Cke, and Massee in "Himalayan Truffle, 1892" listed in 'Fungi of India' by Butler and Bisby[1], it was collected by Duthie in Mussoorie hills.

Botanical Laboratory, S. R. Bose.
Carmichael Medical College,
Calcutta,
*September* 15, 1948.

1. Butler and Bisby, *Fungi of India*, 1931. 2. Dangeard, P. A., *Le Botaniste*, 1894, **4**, 61-87. 3. Massee, G., *Ann. Bot.*, 1909, **23**, 243-63. 4. Parks, H. E., *Micologia*, 1919, **11**, 10-21.

## ACTIVE ELONGATION OF UNSTRIATED MUSCLE

Relaxation of striated muscle is known to be active; see Ramsey (1947) for references. Singh (1944), Singh and Singh (1946), Singh, Singh and Muthana (1947) have described active elongation of unstriated muscle. These experiments, however, were not satisfactory owing either to abnormal stimulus or abnormal saline used. Satisfactory evidence of active elongation during relaxation has now been obtained. Pieces of dog's stomach, if carefully dissected relax actively when stimulated with alternating current (12 volts for 10 seconds). The results are shown in Table I. The muscle was laid in a trough and stimulated isotonically. If the dissection is not good, then the pieces curl or twist and it is then difficult to follow relaxation.

| Experiments No. | Resting length of muscle; mm. | Length during contraction mm. | Length after Relaxation mm. |
|---|---|---|---|
| 1 | 55 | 24 (43, p.c.) | 35 (63, p.c.) |
| 2 | 65 | 40 (61, p.c.) | 65 (100, p.c.) |
| 3 | 60 | 32 (53, p.c.) | 54 (90, p.c.) |
| 4 | 39 | 35 (89, p.c.) | 41 (105, p.c.) |
| 5 | 55 | 31 (56, p.c.) | 46 (83, p.c.) |
| 6 | 66 | 42 (63, p.c.) | 59 (89, p.c.) |
| 7 | 65 | 34 (52, p.c.) | 63 (97, p.c.) |
| 8 | 65 | 43 (66, p.c.) | 62 (95, p.c.) |
| 9 | 52 | 30 (57, p.c.) | 50 (96, p.c.) |
| 10 | 30 | 20 (66, p.c.) | 32 (106, p.c.) |

It will be seen from the table that the relaxation is complete in many muscles. Active relaxation is antagonised by substances that produce tonic contraction, such as excess of lithium, ammonium, potassium, calcium, strontium, barium, bromide, nitrate, iodide, thiocyanate, cyanide, acetylcholine, iodoacetic acid. It is less evident if a strong stimulus is used (50 volts), or if the muscle is asphyxiated or after soaking in saline for about an hour, a procedure which increases tone.

Tonic contraction is then due to interference with active relaxation, in agreement with views recently published (Singh and Singh, 1948).

Physiological Laboratory, Inderjit Singh.
Medical College, Sunita Inderjit Singh.
Agra,
*September* 22, 1948.

1. Ramsey, R. W., *Ann. N. Y. Acad. Sci.*, 1947, **47**, 675. Singh, I., *Curr. Sci.*, 1944, **13**, **311**. Singh, I., and Singh, J., *Proc. Ind. Acad. Sci.*, 1946, **23**, **312**. 1948, **27**, 127. Singh, I. Singh, I., and Muthana, M. C., *Proc. Ind. Acad. Sci.*, 1947, **25**, 51.

# REVIEWS

**Astronomy. By** William T. Skilling and Robert S. Richardson. (Revised edition. Chapman & Hall Ltd., London), 1947. Pp. xii + 692. Price 28 *s/i*.

Astronomy has a special fascination for all educated people, whether trained in the natural sciences or in the humanities. A good book on astronomy can therefore be expected to interest a large circle of readers of one kind or another; but it is not often that one comes across a book on astronomy which is of universal appeal. Skilling and Richardson's *Astronomy* is one of those rare books whose style and breadth of scope will satisfy almost everyone who is interested in knowledge for its own sake and who has stared up at the stars and felt a thrill of awe in the face of mystery and eternity. The first edition (1939) of the book filled the gap which existed between the entirely popular accounts of astronomy like some of the writings of Eddington and Jeans, which made the average man marvel at the astounding achivements of the human intellect in this branch of science, and the highly mathematical and sometimes abstruse books by the same great astronomers and many others, which are intelligible only to the professional astronomer or mathematical physicist. The revised edition (1947) of Skilling and Richardson's book is therefore sure of a welcome from layman and professional alike.

Although the book appears to be planned primarily as a text-book for American college students, its scope is vast,—that is the only adjective which suits. It is divided into three parts under broad headings. Part I is headed "The Earth and the Moon in Astronomy"; it deals not only with the earth and the moon, but also in a general way with the other members of the solar system and even with the essential principles of construction and use of telescopes, spectroscopes and various other instrumental equipment of the astronomer. A more detailed account of the sun and the planets (other than the earth) and their physical constitution comes under Part II which is headed "The Physical Nature of the Sun and Planets". Again the subject-matter of this part is much more comprehensive than the necessarily short title implies; for, in this part, the authors have wisely included a very simple, but quite effective, summary of the basic properties of light, of the ordinary and the radioactive atoms as well as an outline of the modern theories of the origin of spectra, without which the lay reader would be unable to appreciate the results of the study of the physics of the sun and the planets here described. To many readers,—at any rate to the present reviewer—, the highlight of the book would however be Part III, whose title is "The Stars and Nebulæ". Here we have a concise and yet very readable account of the fundamental facts so far discovered, as well as of some of the fascinating theories or speculations concerning the most distant components of the universe.

As I have already said, the scope of the book is vast. This vastness of range is at once the merit and the weakness of the book. The authors have made a praiseworthy attempt to include in a single, essentially descriptive volume practically all important known facts and theories of astronomy. This is humanly impossible to achieve, and the inevitable result has been a certain degree of sketchiness in the treatment of some matters, and some subjects have received inadequate attention notwithstanding their undoubted interest and importance. To mention a few, one would have liked to have a fuller description of the theories of cepheid variation, of the interior of stars, of interstellar matter, of the magnetic fields of stars, etc. Though the book is written in a semi-technical, descriptive style, the authors have achieved a remarkable measure of success in maintaining a high standard of accuracy in the statement of scientific facts. But a few loose statements, though of minor importance, have crept in; for instance, it is not strictly accurate to say that "They (*i.e.*, monochromators developed by Öhman and others) do optically what the spectroheliograph does mechanically" (*vide* p. 167). Again, from the last sentence on p. 364 one gets the impression that prominences projected on the disk of the sun generally appear "as long, dark plume-like markings roughly parallel to the solar equator"; but the fact is that the dark markings definitely show a progressive increase of inclination to the meridians from the equator to the poles, the inclination to the meridians being, on the average, zero at the equator and 90° at the poles.

The book is very well illustrated and has a number of instructive tables and charts, as well as an Appendix which includes a glossary of technical terms used in the text and a list of astronomical and physical constants. It is, I believe, the most up-to-date and informative book on descriptive astronomy that is available at the present moment. The authors, one of whom is a retired college professor and the other an active researcher at the most modern and powerfully equipped observatory in the world, deserve all praise for their planning and writing of this excellent book in which answers in simple language to an amazing number of cosmic problems will be found.

A. K. DAS.

**Fundamental Principles of Ionospheric Transmission Radio Research Special Report No. 17 of the Department of Scientific and Industrial Research and Admiralty. Published by H. M.** Stationery Office, London. Pp. 82, Price 1s 6d. net.

This booklet was issued during the War to the Services to interpret the results of observations of the conditions in the Ionosphere into instructions for procedure in operating the complex

radio services required. As such, it attempts to cater to the needs of a wide variety of readers. A natural consequence of this has been admitted in the foreward itself. It is too detailed and academic for wireless operators and low grade technicians and rather sketchy for the research physicist and engineer. This, however, does not diminish the value of the book. It is a most welcome publication to persons like the reviewer who have to recommend an authentic and accurate account of the Ionosphere and its effect on radio communication to telecommunication degree students and to a large number of technicians receiving an advanced training. To this class of persons, the book is a real boon. The book is also very useful to the large number of physicists who are not specialists in Radio-physics and to the honours students in physics who have examinations to consider.

The book is divided into seventeen sections which include the discussion of the ionosphere as a refracting medium, vertical and oblique incidence, transmission curve technique, reflection from multiple layers, determination of actual heights, effect of the earth's curvature, effect of the earth's magnetic field, characteristic polarisation of waves, absorption, formation of the ionosphere, diurnal and seasonal variations, echoes, scattering, effect of sunspot cycle etc. The treatment is everywhere simple and straightforward. The use of mathematics is reduced to a minimum. All the statements are accurate and clear. The diagrams are very neatly drawn and very illustrative.

The ray treatment is followed everywhere. This is very useful and makes explanations easy. There is, however, another view. The reviewer is strongly of opinion that it is desirable to follow the full wave treatment and where this is not possible, the results only should be stated. Over-emphasis of the ray treatment may lead to wrong conceptions in the mind of the inexperienced reader. This is the only, if it considered so, a defect of this otherwise excellent book.

On the whole, the book is a very brief but very clear and authentic monograph on Ionospheric Transmission and is certainly worth many times the price for which it is put on sale. It is indispensible to College libraries and can be strongly recommended as a text-book to a wide variety of readers.

S. V. CHANDRASHEKHAR AIYA.

**Electron and Nuclear Counters.** By Korff. D. Van Nostrand & Co., New York publication & Macmillan & Co., as agents 1948. Price $3·22 or 18*s.* net.

This book was first published in April 1946, reprinted in September 1946, April 1947 and January 1948 and has 212 pages. The author is Professor of Physics and Supervisor of Physical Research, College of Engineering, New York University. In this book is gathered together and summarized pertinent facts regarding the theory of the discharge mechanism and the practical operation of various types of counters. As well pointed out in the book, counters have been known for about 40 years, still their construction and operation are claimed by many competent physicists as almost involving "magic". Various laboratories have indeed developed special procedures for their construction and use, often not fully understanding why particular technique appear to be most successful.

In the book we have first a discussion of the internal mechanism of the discharges in the counter and then of the constructional and operational features which are desirable and the means adopted to secure them. Subjects discussed include the usual and commonly used counters as well as those for special purposes and those selectively sensitive to particular types of particles, such as those which preferentially count neutrons in the presence of a strong background of gamma radiation.

The first chapter serves to introduce the subject and to describe the progressive changes in the behaviour of he counter as the voltage is gradually raised. The terminology to be used in describing the counters is next defined. Then the operation of the instrument, first as an ionization chamber, then as a proportional counter, and finally as a Geiger counter, is developed and the theory and operation of each different type of counter is set forth. The practical aspects are next considered and the construction of counters is taken up. The reasons for the various constructional features are given. The errors and corrections encountered in using these devices are discussed. Finally, the various electronic circuits, which are the essential auxiliaries to the successful operation of various kinds of counters, are presented.

The counter is a basic instrument in the modern day atomic research just like the galvanometer has been ever since the early days of electrical science for current electricity. Prof. Korff's is the first book of its kind in the English language and no student of research or even a teacher expounding the field of recent atomic research can well remain without possessing a copy of this book.

B. DASANNACHARYA.

**Mechanical Behaviour of High Polymers.** *High Polymers*—Vol. VI. By Turner Alfrey, Jr. (Interscience Publishers, Inc., New York), 1948. Pp. vii + 581. Price $ 9·50.

This moderately priced and elegantly got up book forms Vol. VI of the famous High Polymers monographs on the Chemistry, Physics and Technology of High Polymers edited by Prof. H. Mark and his colleagues. In this volume Turner Alfrey, Jr. has dealt with the fundamental princ ples underlying the visco-elastic behaviour of high polymers in relation to the molecular structure, amorphous, crystalline, linear or cross-linked. As only a few of the important high polymers are studied so far from this point of view by Rivilin and Kirkwood, the mechanical behaviour of high polymers such as elasticity, viscous and plastic flow, is discussed on semi-empirical grounds based on the research in the author's laboratory.

This book sets forth a model for further study of similar fundamental studies on the myriads of high polymers not only on the visco-plasto-elastic property which governs the practical application of these polymers but also on the concomitant changes in

molecular structure as revealed by electrical and optical properties such as dielectric constant, double refraction and light scattering by infra-red and X-rays and by other physico-chemical methods such as swelling, adsorption, etc.

The next volume of the High Polymer series deals with phenoplasts, their structure, properties and technology. These books form a valuable contribution to our knowledge of the Physics and Chemistry of Plastics.

S. K. K. JATKAR.

**The Science of Plastics Edited** by H. Mark and E. S. Proskaur. Vol. I (Interscience Publishers, Inc. New York). 1948. 632 pages. \$9·00.

The publishers have contributed this volume I on the progress of the Science of Plastics during the years 1942-1947 reprinted from the original Abstract Service 'Resins, Rubbers and Plastics' issued in loose leaf form, with a comprehensive Index. The book deals with general properties, physical chemistry, reaction kinetics and technology and with general aspects of different types of Plastics.

These abstracts unlike the usual ones give all the important information such as the skecth of apparatus used, procedure, experimental data (or figures), etc., required by the research workers and technologists, and make it unnecessary to refer to the original papers published in journals, most of which especially the continental ones are not easily available. The value of such moderately priced books to students of Plastics can hardly be overestimated. The progress of research on the Chemistry and Physics of Plastics is so rapid and the practical applications so many, that very few scientists could afford to neglect the up-to-date position of the science of plastics.

Such comprehensive *source* books are far cheaper than the usual text-books. The method of printing has in no way taken away the clarity of presentation or the get-up of the book.

We look forward to the publication of abstracts of papers on Vol. II which will deal with single plastics.

S. K. K. JATKAR.

**Chemical Composition of Plants as an Index of Their Nutritional Status.** By D. W. Goodall & F. G. Gregary. (Imperial Bureau of Horticulture & Plantation Crops, Great Britain), 1947, Pp. 167. Price 9*d*.

This technical communication from the Bureau of Horticulture and Plantation Crops is a very welcome addition to the literature on the subject of plant nutrition and the detection and measurement of nutritional deficiency of field crops. It is devoted mainly to an exposition of the practical application of methods based on chemical analysis of plants for the determination of fertiliser needs of plants.

The book opens with a brief but concise account of the various methods of diagnosis now in vogue, *i.e.*, pot culture studies, field trails, soil analysis, analysis of plants and the observation of symptoms associated with the deficiency of particular nutrients. Then follows a historical account of the progress of methods based on chemical anaylsis of plants, the various theories advanced from time to time on the relationship between the composition of the soil, the plant and the added nutrient and of the present position of the technique in practical agriculture. The rest of the book is devoted to a comprehensive account of the method of diagnostic plant analysis. The treatment is very thorough, and details as to the technique and method and manner of sampling, analysis and interpretation of results, the limitations of the method in practical advisory work are all treated in full. The results of previous workers are discussed in their proper sequence and illustrated with paintakingly collected statement of the results. The advantages of the plant analysis method over other methods is briefly discussed, and the reliability of the results and great rapidity with which they can be obtained are stressed.

The problem of crop yields in relation to fertilizer supply is now engaging the urgent and earnest attention of scientists and others all over India. In the present context of inadequate food supply and undernourishment, the problem is one of added importance. The workers in the various agricultural departments all over India will find this book of immense value. The Indian workers have so far relied on the traditional, timeconsuming methods of soil analysis and field trial to guide them in their efforts to study the fertiliser requirements. Diagnostic plant analysis has not yet received their practical attention. It is a new field with immense possibilities for India where rapid and reliable diagnosis of soil and crop requirements is now an urgent necessity.

The authors have compiled an exhausting bibliography, which alone would make it worthwhile to own a copy of the book.

B. D.

**Using Salty Land.** An F.A.O. study prepared by H. Greene, Soils Specialist, Land Use Branch, Agriculture Division of the United Nations. (Published: Washington, U.S.A.), February 1948. Price 50 cents.

This is the third number of the F. A. O. Agricultural series and is an excellent small monograph running over 49 pages. Written by one who is a specialist in the field, it is easily understood by the layman and of great interest to the technician. It is of great topical interest as the food production of the world consequent to the World War II is very much below that required by the population. With the establishment of peace and the increase in population that must be expected hereafter, every acre of land that can produce food must be utilized and brought under cultivation. This little book tells of the past trials and successes of bringing salty land under cultivation—land that had once been considered unfit for growing crops.

After dealing with the processes that cause the formation of salty soils, it recounts briefly the reclamation experiments conducted in Egypt, Sudan, North China, Sanjoaquin valley, California, U.S.A., in Northern India, in the Poltava region and the lower Volga region of the U.S.S.R and in Hungary. A brief review

of the work of the Russian Soil Scientists is made based on the account of D. G. Vilensky and the formation of Solonchak, Solonetz, and Solodi described.

Further chapters are devoted to base exchange complex of Solonetz and Solodi, Marine reclamation and a very sufficient account of the problems of reclamation, of removing excessive salts, removal of exchangeable sodium magnesium and hydrogen follows. Irrigation problems, the salt content of irrigation water and the relationship between the salt content of the irrigation water and the salt content of soil and alkalinity of the soil to be reclaimed through irrigation is presented in a very attractive manner.

The last chapter deals with organization that has to handle the problems of reclamation. "There are broadly two ways of undertaking a large-scale project. The administrative authority may take over the whole task providing both the money needed for development and the technicians to carry out all stages of the work. This method is used in the U.S.S.R. and was notably successful in the Tennessee Valley, U.S.A.

On the other hand it is possible in some cases to balance the main items of capital expenditure against increased production from the reclaimed land. It may be convenient for the administrative authority to entrust the main work of reclamation to a commercial corporation, which would buy salty land at low price, reclaim it and sell it at high price. The directors of the commercial corporation can make the general and local surveys in sufficient detail to protect their own interests and the administrative authority can ensure that the profit gained is not unreasonable. The administrative authority will incur additional expenses of a recurrent kind and will be recouped by the increased value of land adjoining that actually reclaimed and by increased revenue from a number of sources...... "It is usually to the advantage of both parties for reclamation to be carried out on a small scale for a few years before the major agreement is made. This system is appropriate to our economic system in which individuals put money and labour into a project in the hope of gaining profit; it also has the advantage that the administration incurs less expense and is less burdened by supervision of details".

Mr. Greene concludes, "In any case success depends on a first evaluation of the physical conditions and on the effective and continued co-operation of people having varied skills."

N. G. C.

**Veterinary Education.** By Prof. Beveridge. (Cambridge University Press), 1948. Pp. 40. Price 1 *sh.*

It is a matter of great pleasure to read the booklet since it is not only rich in facts and figures, but unique in its presentation and information in its details. The author has taken great pains to collect information regarding the progress of Veterinary Education from as early as 4000 B.C. Unfortunately he has restricted himself to Western World only, probably because he could not get enough material to trace the development of this science in the East. He has very ably shown how humanity has transferred some of its disgust towards animals to Veterinarians for no fault of theirs. The author deserves congratulations for a pioneer attempt to remove false impressions and ridiculous associations of the word "Veterinary" in the minds of the public. His remarks regarding the details of Veterinary Curriculum are naturally based on his own experience and though the basic principles cannot be ignored, the details as given by him will have to be modified to suit a particular country. His call for a closer collaboration between Medical and Veterinary professionals in the field of research deserves greatest appreciation. The spirit of co-operation between research workers in such diverse fields as Agriculture, Veterinary and Medical or any of the pure sciences towards a common goal, namely the progress of humanity as a whole, is certainly the greatest need of the day, and the author has correctly hinted at that in his writing.

The booklet is written almost in the form of a brief extract and therefore certain important points are only touched and not dealt with in detail, for instance the subject of animal psychology and its place in present-day Veterinary Education. The author has enunciated a very sound dictum that the aim of Veterinary Education should be to produce graduates whose minds are malleable and who will continue throughout the rest of their lives to absorb and use new knowledge. The book makes its appearance at a very critical period in human civilisation when the acute struggle is going on between mechanisation under the name of industrial progress and spiritual enhancement of human society. If the world were to think of animals only as a means of transport or articles of food, then surely the soul of man has degraded itself, since it cannot appreciate the soul of animal and values only the body of the animal. Prof. Beveridge has rightly said, "In this age of Mechanization we are perhaps apt to forget the tremendous part played by domestic animals in our History."

The Professor has also given a correct conception of Veterinary Science when he says, "It is largely to these lossess by Animal Plague that modern Veterinary Colleges owe their origin."

The book is really entertaining in some of the quotations given by the author from old law books and scriptures.

Any one interested in Veterinary Education can refer to this book with pleasure and those who are indifferent will certainly change their feelings about Veterinary world if they go through this book.

S. R. CHADHA.

**Botanik der Gegenwart und Vorzeit von Karl F. W. Jessen** (Republished by The Chronica Botanica Co., Waltham, Mass., U.S.A.), 1948. Pp. 528. Price \$6·00.

The book under review forms the first volume of offset reprints of out-of-print classic scientific works under the new series *Pallas.* The task

of rendering into scientific precision any historical account of a branch of science, especially biology, is not a light one. In this extremely difficult line Jessen has maintained the German tradition of the nineteenth century when books of a similar type were published by contemporary botanists like Sachs, Meyer and others. Admittedly this little book has a fund of information on all aspects of botanical work in the nineteenth century. To those of us who are almost stupefied by the increasing output of diverse types of researches with a strong bias towards the application of Physical Sciences in the new approaches of botanical investigation, it is refreshing to read about the very conservative and pure line approach of problems of botanical interest during the last century. Quite rightly, Dr. Verdoorn points out that "today it is almost impossible to write a short history of botany in one single volume of limited size as Jessen was able to do." One has to appreciate the cultural aspects of the work and the humanistic approach to a historical account and this has been admirably fulfilled by Jessen. To all lovers of this history of botany the reviewer warmly reommends the book, written in simpple yet elegant German, and most probably is a unique production which will be appreciated for its fund of information of nineteenth century botanical progress. Dr. Frans Verdoorn is to be congratulated for bringing this new series which makes available older classical literature which are so rare and difficult to obtain.

T. S. Sadasivan.

**Diseases of Cotton in India,** By B. N. Uppal, (Indian Central Cotton Committee), 1948., Price Rs. 2.

The present status of our knowledge regarding diseases of cotton, which is an important crop in India extending over 20 million acres, is summarised in this publication. Seventeen diseases of cotton are described most of them being of minor importance in general, though occasionally they assume an epidemic form, except cotton wilt and cotton root rot, which are serious diseases caused by soil bourne organisms. Of some importance in certain areas are dry rot, anthracnose and red blight, the last one attacking only American cottons. A comprehensive summary of work done in India on these diseases over a period of 25 years is presented by the author paying special attention to etiology, control measures, etc., which will be of value to research workers in this field. Two of the diseases cotton wilt and cotton red rot are described in greater detail than the rest of them. The value to the research worker would have been greatly enhanced if an attempt had been made to correlate the details of the work done in India with work done in other countries on the same or similar diseases. For instance the real cause of wilt (*Fusarium vasinfectum* Atk.) in cotton, once considered to be due to the accumulation in the cells of aluminium salts, is now stated to be due to a chemical compound which remains active after boiling and after passage through a porcelain filter. It is said that the filtrate is not destroyed by heating in an autoclave at 110-115° C., and that the nature of the substance is not fully known. It is twenty years ago that the above mentioned results had been obtained by workers in India. Now, it will provide useful information to a research worker on this disease, if mention has been made about the work done by Gaümann an Jaag (Experientia Vol. II, 1946) on the problem of wilt diseases in plants. They found that a plasma poison named *Lykormarasmin* produced by Fusarium lycopersici caused pathological wilting of tomato plants at a dilution of $10^{-2}$ mol and $10^{-3}$ mol. A similar substance of the Marasmin group ($C_9H_{15}O_7$ $N_3$ is possibly the cause of wilt in cotton. While no doubt a lot of information has been collected by the author from pulbished and yet unplublished articles, and from information elicited through letters, all of which are presented in this useful pulbication, correlation of results obtained by workers in India, with those obtained in other countries on cotton diseases will be helpful to future workers. However, we have, in this publication an excellent and comprehensive summary of work done in India on cotton diseases, which will be of great use to workers in this line, both in the laboratory and in the field.

M. J. N.

## ANGLO-U.S. EDUCATIONAL AGREEMENT

An important agreement has been concluded by Britain and the U. S. which will benefit students in both the countries. The agreement was signed by Mr. Bevin, Britain's Foreign Secretary, and the United States representative in London. A Joint Commission of 12 is to be set up in London, the American members being appointed by the American Ambassador and the British members by the Foreign Secretary.

It will recommend how the \$50,000,000 realised from the sale of United States surplus property in Britain shall be spent on educational facilities for the benefit of students undertaking advanced studies in both the countries. This use of the fund from the sale of surplus property is authorised by a United States legislation known as the Fulbright Act. Senator Fulbright was himself present when the agreement was signed.

It is a great post-war experiment based on the feeling that the solution for international problems can be found if people in all countries can be brought to know each other as free men. It is obvious that increased understanding between the United States and Britain resulting from this interchange of students, teachers, professors, and research workers will be of the highest importance.

This fund will be devoted mainly to finance the studies of American students in Britain and the Commonwealth as also of British and Commonwealth students in the United States. Educational programmes will be planned and the teachers, professors and research workers selected to participate in them will be chosen by the Commission.

# SCIENCE NOTES AND NEWS

## Reorganisation of Medical Libraries in India

Dr. D. V. Subba Reddy, Officer on special duty, Madras Medical College, writes:—

There are a number of valuable old medical books, printed in various countries of Europe in the 18th and 19th centuries, lying unknown and unutilised in India and gradually disappearing or disintegrating.

The Government of India have recently approved of a scheme to search for salvage and examine the old medical books in various libraries in India with a view to prepare a special catalogue of these valuable books. Circulars have been sent to all the Medical Colleges and other Medical Institutions in India, requesting lists of such old books for detailed examination. Some of the books will have to be photographed to show the title pages or illutrations. An analysis of the contents and the importance of the books as well as biographical notes of the author will have to be added.

Special attention has to be given to old medical books, dealing with the health problems and diseases of India and neghbouring countries, and also to those books written by various medical men serving in India, either as East India Company's doctors or as surgeons attached to Native States or private Missions.

Some of these books have been printed in India and may not be available easily in Western countries and libraries. Their existence or contents are unknown to European and American teachers and writers on Medicine. Even in India all the books printed in India on diseases of India in the 18th and 19th centuries, are generally unknown to the Indian medical profession. When somebody knows about the existence of an old medical book, it is not available in certain parts of India. There is no list of such old books and whether they are available in India and if so where.

May I request your readers to pass on any information they have, regarding the existence of old medical books, particularly those printed in India or manuscripts, in any private collection or in the private libraries of the medical practitioners of the last century. Many of the private libraries of the Native States zamindars, educated and cultured families, missionary establishments, various printing presses and publishing houses, may have a few valuable old medical books, which may not be available in the public or medical college libraries. All lists of such books or the addresses of persons where such books are available or even the books themselves may be sent to me.

## Dr. J. N. Mukherjee

Dr. J. N. Mukherjee, Director, Indian Agricultural Research Institute, New Delhi, has been invited by the Organising Committee of the Fourth International Congress of Soil Science (Amsterdam) 1950 to become one of the Vice-Presidents of the Congress.

The Economic and Social Council of the United Nations has called a United Nations Scientific Conference on the Conservation and Utilisation of Resources to be held in the United States in May or June 1949. Dr. Mukherjee has been invited to prepare a paper on Tropical Climates for presentation before the sectional meeting on "Improving soil productivity".

## Cellulose-bearing Matetials other than Cotton for Rayon Manufacture

Investigations conducted at the Technological Laboratories of the Indian Central Cotton Committee show that certain species of bamboo, reeds, bagasse, jute fibres, etc., can yield pulps suitable for rayon industry by employing modifications in the normal treatment. The pulps obtained after processing these raw materials under optimum conditions of kier boiling and bleaching have been evaluated and it is found that they compare favourably with the imported pulps for rayon manufacture.

## Oil from Kamala Seed

The chemical examination of the seeds of the Kamala plant *Mallotus philippinensis* (which is noted for its dye importing a beautiful, deep bright, durable orange colour to silk), made at the Chemical Laboratories of the Council of Scientific and Industrial Research, Delhi, shows that the oil is yellowish brown in colour and polymerises to a rubbery mass in about a fortnight. With lead linoleate as an additive, the oil gives rapidly drying film as in the case of tung oil.

## Wood Corrosion and Hot Chemicals

The effect of hot chemicals on Cypress both in the natural state and after various protective treatments, is described in the Indian Forest Leaflet No. 101, which has just been published. The treatments studied showed varying degrees of protection, phenol formaldehyde generally being the best. Cypress was found to be resistant to hot sulphuric acid upto 10% even when unprotected.

## Dr. Frans Verdoorn

Dr. Frans Verdoorn, Managing Editor of *Chronica Botanica*, has been elected a Corresponding Member of the International Academy for the History of Science in Paris and Chairman of the newly established International Phytohistorical Committee of the International Union of Biological Sciences.

Editor: M. Sreenivasaya, B.A., F.I.I.Sc., F.A.Sc.
1140-48 Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore

# Current Science

Vol. XVII] NOVEMBER 1948 [No. 11




## WORLD'S PROSPECT OF FOOD AND AGRICULTURE

IN the course of an illuminating survey of the world conditions and prospects of the state of food and agriculture, the Food and Agriculture Organisation has highlighted the main achievements of the combined efforts of the United Nations in bringing relief to a hungry world. The survey shows that "millions of people are still hungry; world population is increasing more rapidly than production; soil erosion impoverishes many lands; forest resources are being depleted; the introduction of modern farming methods encounters serious difficulties; low income countries lack money for investment projects; international trade is seriously out of balance; and in the technically advanced countries there is growing concern as to whether markets can be found for the surplus food which they are able to produce."

The overall production of foods and fibres in the world still remains inadequate and the Nations particularly of India and the Far East are not doing and striving enough to cope up with the world's long-term requirements. It is generally felt that this depressing circumstance is counter-balanced by the hopeful fact that we have in our possession enough technical knowledge which could be mobilised and harnessed in bringing about a substantial, even dramatic, increase in food production. As the F.A.O. Director-General Dodd adds in his Foreword to the Survey, "the difficulties which stand in the way of a really rapid expansion of production should be examined

more energetically by Governments, and decisions should be taken which will enlarge the programme and facilitate their speedier execution. There have been enough generalisations; what is now needed is practical action."

The survey describes in considerable detail the current situation in relation to consumption, price trends and international trade. The coming three years are considered to be crucial and it is expected that by 1950 the situation as regards production and consumption of food might reach a well balanced stage of sufficiency. This optimistic outlook is however subject to the condition that no unfavourable weather conditions would intervene during the period. So far as the Far and Near Eastern countries are concerned, the problem is more complicated. Low *per capita* incomes, lack of mechanical equipment backwardness of industries, exhausted soils, lack of natural and artificial fertilisers, low efficiency of the bullock power due to inadequate and unbalanced feeding and the reduced efficiency of the human population due to malaria and malnutrition these constitute formidable obstacles to agricultural and to general economic development.

The 'grow more food' campaign sponsored by the Central, Provincial and other State Governments in India has not proved so successful as one would desire. The country continues to depend upon import of grains from foreign sources in ever-increasing quantities. Although the acreage under cultivation according to official sources, has increased, there has been no corresponding increase in the yield of crops. This is due to the poverty of our soils which need almost all the constituents of a good fertiliser. If fertilisers can be secured in adequate quantities, there is little need to extend our acreage. With better and more intensive methods of cultivation, and adequate manuring, the existing acreage can be made to contribute towards a considerable shortening of our food deficit. The extension of acreage under the auspices of the 'grow more food' campaign has been mostly accomplished at the expense of pasture lands and forests, which would appear to be undesirable from the point of view of the welfare of our cattle, forest resources and rainfall. There should be a close interrelationship between agricultural policy and forest policy.

One of the potential sources of food which has not been adequately exploited is represented by the world's fisheries. The great bulk of the world's fish supply is at present caught in relatively small areas of the North Atlantic and North Pacific. The waters around Africa, Latin America, and South Asia have yet to be investigated to ascertain their yield capacity. Nor should the development of new freshwater fisheries be overlooked, especially in connection with irrigation projects.

The F.A.O. survey invites pointed attention to the conditions of ill-health and low vitality which impede the progress of agricultural production. Before the war it was estimated that nearly one-third of the world's population (about 650 million people) suffered from malaria. In the decade from 1932-41, 37 per cent. of the people of India died from that disease or its consequences. Intestinal diseases and parasites take an additional toll; for instance, half of Egypt's population suffers from bilharzia. Ill-health means reduced efficiency while people are working, and it also shortens their working life. The Indian born in 1931 had a life expectation of 26·5 years; the Englishman born in the same year, a life expectation of 61 years. This meant that pre-war India spent 22·5 per cent. of its national income on raising children who would make hardly any contribution to production, while England spent only 6·5 per cent. of its national income on the raising of children.

Efforts to improve education, health and other social services need to be considered as an indispensable counterpart of agricultural development. It is just as essential to have a school and school teacher to awaken the mind as it is to have fertilizer to stimulate the soil. It is just as essential to have a doctor as it is to have a veterinarian or a supply of pesticides. Indeed, a major attack upon rural conditions is a vital element in the battle of food production.

# CYTOGENETICS OF *NICOTIANA TABACUM* VAR. *VIRII* RESISTANT TO THE COMMON TOBACCO MOSAIC VIRUS*

DONTCHO KOSTOFF

(*Central Agricultural Research Institute, Sofia ,Balgaria.*)

THE cytogenetics of plant forms obtained from interspecific and intergeneric crosses is of great significance in evolutionary and plant-breeding problems. Unfortunately very few of such crosses have been studied throughly. I have made such studies in the crop plant genera *Triticum, Secale, Nicotiana,* etc., and wish to deal here with the inheritance of a physiological characted for virus resistance in *Nicotiana.*

The work was started with the aim of producing form of *Nicotiana tabacum* resistant to the common tobacco mosaic virus. This was to be secured by interspecific hybridisation of *N. tabacum* with a species which resists the virus, by producing localised necrotic reaction, and deriving from the hybrid a resistant tobacco plant with $2N = 48$ chromosomes. The expectation was that gene or genes causing resistance could be transferred to chromosomes of *N. tabacum.* This was accomplished in two ways. Firstly by crossing two hybrids, (*a*) *N. rustica* RL × *N. tabacum* Basma and (*b*) amphidiploid *N. glutinosa-tabacum*,, and the $F^1$ of this cross, was back-crossed to *N. tabacum* twice and selections selfed for homozygosity. Secondly, *N. tabacum* was repeatedly back-crossed to the amphidiploid, *N. glustinosa-tabacum*, and again selections selfed for homozygosity. Virus-resistant tobacco plants thus produced were called var. *virii*[2].

*N. glutinosa* and a particular variety of *N. rustica* used in the crosses, show resistance to virus by localisation of virus around the source of infection. In all *N. tabacum* varieties, and in other varieties of *N. rustica* the virus spreads and kills the plants.

In this and other wide crosses, detailed cytogenetical analysis is essential to learn the evolutionary and plant-bleeding value of the crosses.

In the present instance the cytogenetic problem can be stated in the following terms. The dominant gene which restricts the spread of the virus (here termed Vr) has been transferred from another species to *N. tabacum.* Has the transfer been accomplished by transfer of a *segment* of a chromosome or by addition or substitution of an *entire* chromosome? The latter alternative means that in the resistant plant there are 23 pairs of *N. tabacum* chromosomes and one pair of foreign chromosomes (*glutinosa* or *rustica*) or even possibly 24 pairs of *N. tabacum* and one pair of foreign chromosome (designated Nch) making a total $2N \approx 50$. This last possibility, that is production of a stable form, with an additional chromosome pair of another species, was first suggested by the Russian worker M. Ternovsky[3] in 1935 and again by Gerstel[4] in 1946.

The present investigation supports the explanation given first. Our conclusion is, that resistant plants are usually produced by the cross-over of a segment of chromosome Nch, containing gene for resistance to *N. tabacum* chromosomes. Gerstel studying Holmes' material and his own material assumes the other possibility, namely entire Nch chromosomes has been substituted or added. He had at hand my statement upon this problem, but did not consider it.

The cytological observations supporting the explanation offered is therefore important. Primary evidence is this. My observation is that in an interspecific cross, two to six chromosomes of *N. glutinosa* conjugate frequently with those of *N. tabacum*, contradictory to the observations of some other investigators. It is evident that conditions under which the $F^1$ develops influences the degree of chromosome conjugation. Occurrence of conjugation is responsible to a great extent for the inconstancy in the amphidiploid *glutinosa-tabacum*, which was shown by Muntzing.[5] Gerstel holds the view that "the transfer of genes from one species to another is impossible, because of failure of chromosomes to conjugate and to cross over in the hybrid," and also that there is lack of homology between the chromosomes concerned. However, Gerstel's view that a substitution of homologous chromosomes can occur, contradicts his own arguments, and supports the present observation.

The meiotic stages in hybrids between the virus resistant tobacco. *N. tabacum virii*, with closely related susceptible varieties of tobacco have been studied by me, and supports my interpretation. Two examples are given here. In the $F^1$ hybrids of *N. tabacum virii* 'alba' and *N. t.* 'Nevrocop Basma' the complete regular pairing was observed in 108 P.M.C. and only in 7 P.M.C. did 23 pairs and two univalents appear. In the $F^1$ of another cross *N. t. virii* 'alba' with *N. t.* Serska Basma regular pairing was seen in 84 P.M.C. and univalents only in 4 P.M.C. These data show that in the majority of the cases, the chromosome carrying the dominant gene Vr for virus resistance, conjugates readily with its pure *N. tabacum* partner. Only in a few cases (7·4% and 4·8%) the conjugation fails, which can be accounted for by the non homologous segment carrying Vr gene. These data can be interpreted by assuming that the chromosome segment controlling virus resistance has been tranferred from one species to another, by cross-over in the interspecific cross. In other words we have a transfer of an important physiological character from one species to the background of another, preserving the chromosome number and homology of the economic species. This factor facilitates further breeding work, *i.e.*, the transfer of the resistance gene to any other economic variety. Cytogenetic work appears here as distinctly separated from plant-breeding work. On the one hand study of cytogenetics

---

*This Article by Dr. Kostoff which is likely to be of interest to all plant breeders, has been altered from its original form, the editing having been done to make it conform to accepted standard of English diction and idiom.—(*Editor's note*)

of species and their hybrids gives a background for accomplishing the transfer of a desirable gene or gene-complex from one species to another, preserving the genom of the latter plant. At this stage cytogenetic work ends and the plant-breeding work begins, using the derived form for transferring the new characteristic to such economic varieties, as desired, for different localities and purposes.

A synthetic species alike to *N. tabacum* was produced by me[6,7] in 1936, using two genoms of *N. silvestris*, and two genoms of *N. tomentosiformis* and similar work has been done by Greenleaf[9] in 1941. Stebbins[8] gives the data, but gives priority to Greenleaf, however. This data, and observations in other *Nicotiana* species hybrids, done by me, show the chromosome homologies in the different species. In *glutinosa* × *silvestris* 1-5 bivalents, in *glutinosa* × *tomentosiformis* 5-8 bivalents and in *glutinosa* × *tabacum* 2-6 bivalents are formed frequently. This behaviour suggests possibilities in breeding by transfer of a segment or entire chromosome from one species to another.

Even Gerstel's data are in favour of this conception, as he suggests possibility of a exchange transfer of an entire chromosome.

From plant-breeding point of view, substitutions of an entire chromosome pair from a wild into a cultivated species is not desiable, as the entire chromosome can contribute undesirable characters. In the present work, *N. tabacum* var *virii* enabled me to produce by hybridisation and selection, virus-resistant plants having good yield and excellent quality. It is doubtful if such quality can be obtained if an entire chromosome pair had been substituted.

From evolutionary and plant breeding point of view, chromosome substitution has restricted possibilities in production of new forms, as compared to possibilities by a transfer of a gene or small group of genes. The genomic background of a species is less affected by the transfer of a small portion of a chromosome. In addition, fertility of the new hybrid is not much affected. In plant breeding, such forms can be used to transfer the new character to other varieties. I shall not be surprised if in a short time all cultivated tobacco varieties are corrected in this respect, *i.e.*, all of them made resistant to the common tobacco mosaic virus with the use of *N. t. virii*.

This paper is to show once more that cytogenetics both stimulates the development of other biological sciences and gives a real background for the development of applied sciences—in this case contributing to the production of newer and better crop plant.

Thanks are due to R. Georgieva and D. Tzikov for help throughout this work.

---

1. Kostoff, D., *Phytopath. Zeitschr.*, 1937, **10,** 578-93. 2. Kostoff, D., "Resistant tobacco varieties against mosaic virus experimentally produced, Sofia", 1944. 3. Ternovsky, M., *Zeitschr. f. Zuchtung, Reihe A. Pflanzenzuchtung*, 1935, **20,** 268–89. 4. Gerstel, D. U., *Genetics*, 1946, **31,** 42–427. 5. Muntzing, A., *Hereditas*, 1935, **20,** 251–72. 6. Kostoff, D., *Curr. Sci.*, 1936, **4,** 872. 7. Kostoff, D., *Compt. Rend. (Doklady) Acad. Sci., USSR*, 1938, **18,** 7. 8. Stebbins, G. L., *Advance in Genetics*, 1947, **1,** 403–29. 9. Greenleaf, W. H., *Genetics*, 1941, **26,** 301–24. 10. Kostoff, D., *Cytogenetics of the Genus Nicotiana, Sofia*, 1941–43, **1–28,** 1–1071.

## FELLOWSHIPS TO FRENCH GRADUATES

WITH a view to strengthening the cultural bonds between India and France, the Ministry of Education, Government of India, propose to award nine Fellowships to suitable French graduates for research work and teaching in Indian Universities in 1949. This is in response to the interest shown by the French Government in cultivating the study of the Indian languages and literature amongst the French people.

Last year the French Government awarded nine scholarships to Indian students. They have awarded another ten scholarships in the current year. They have also sent out three French students to India to study Hindi and another student is coming shortly to study Sanskrit literature.

The value of the Fellowships to be granted by the Government of India has been fixed at Rs. 500 per month for a period of two years plus the cost of second-class return passage. Each Fellow would be expected to undertake teaching in the French language and literature at an Indian University in addition to his own work. The actual number of Fellowships granted will depend on the response from the Universities.

In a letter addressed to the Vice-Chancellors of Universites in India, the Ministry of Education have proposed that the cost of each Fellowship may be shared equally between the Government of India and the University at which the Fellow will be placed. By this means, the University will secure an efficient tutor of French language and literature at a cost of about Rs. 250 per month and half the share of the passage.

There has been a rapid development of our foreign contacts and there is a growing demand in Indian Universities for instruction in foreign languages. It may even be possible to secure as Fellows French students competent to give instruction in French as well as other European languages.

From the cultural view-point also, it is felt that India should adopt a wider outlook and should take all possible steps to encourage the promotion of reciprocal cultural exchanges with foreign countries.

The Government of India have asked each University to let them know if it would be willing to accept one or two Fellows and would be prepared to meet half the expenses as proposed by the Government.

# ON ESTIMATING THE AVERAGE DEPTH OF RAINFALL OVER AN AREA AND THE DISTRIBUTION OF RAINGAUGES

K. S. RAMAMURTI
(*Poona*)

## INTRODUCTION

HE average depth of rainfall over an area is isually calculated as the arithmetic mean the rainfall amounts recorded at all the ingauge stations in it. The India Meteorogical Department is adopting this method arriving at the mean rainfall figures for e various subdivisions of India.

Satakopan and Vittal Sarma[1] have made study of the optimum number of rain-recordg stations required in catchments for timating run-off. They have also calculatthe average rainfall as the arithmetic mean the rainfall amounts recorded at various itions in the catchment, though they refer to e unsatisfactory distribution of the raingauges er the area. In addition they have assumed at the variability (s.e. is considered) of average to be $\sigma/\sqrt{n}$, where $\sigma$ is the standd deviation and $n$ the number of observations. has been pointed out that this assumption lds good for distributions which are not ghly skew.

The average depth estimated as indicated ove will be subject to an error even when e raingauges are evenly distributed; but ll give an altogether erroneous idea of the in amount if the raingauge stations are dly distributed, *e.g.*, majority of the gauges e located in the region with more rainfall hile a few only are in the region with less infall or *vice versa*.

In this note the distribution of the raincording stations necessary for calculating the erage rainfall over an area as the arithmetic ean of the observed values is discussed. ie maximum error in the estimate is also udied under some simplifying assumptions garding the rain-field. A general suggestion garding the distribution of rain-recording ations over the country is made.

## DISCUSSION

The variation of rainfall in space is a mplex phenomenon. In the following scussion continuity of rainfall in space has een assumed. It may be mentioned that atial continuity could be assumed in ises when rainfall is widespread, or when nsidering the monthly, seasonal, etc., total mounts. Drawing of isohyets is based on this sumption.

The total rain amount over an area is $\int_D R\,dA$

here R is the rainfall at any location in the egion D and $dA$ is an element of area around ie location. The integration is taken over ie whole region D. The mean depth of rain ater is $\int_D R\,dA / \int_D dA$.

Let C be the boundary of D. Let the number f raingauges in the area be sufficient to draw sohyets at an interval of $\tau$ and let these sohyets divide D into sub-regions $D_1, D_2 \ldots$ $D_n$ with areas $a_1, a_2, \ldots a_n$. Here $D_p$ includes all the sub-regions in D lying between the same isohyets.

Then $$\int_D R\,dA = \sum_{m=1}^{n} \int_{D_m} R\,dA$$

Let $R_m = \frac{1}{2}(R_{max} + R_{min})$, where $R_{max}, R_{min} \subset D_m$. That is, $R_m$ is the average of the rainfalls at the two bounding isohyets.

The total rain amount may now be estimated as

$\sum_{m=1}^{n} R_m a_m$ and the error in this estimate is

$$\sum_{m=1}^{n} \int_{D_m} (R - R_m)\,dA \ldots . \because R_m a_m = \int_{D_m} R_m\,dA$$

$$|R - R_m| \leqslant \tau/2, \ldots R, R_m \subset D_m$$

$$\therefore \text{ the error} \leqslant \tau/2 \sum_{m=1}^{n} \int_{D_m} dA$$

$\leqslant \tau/2 \cdot A$, where A is the total area.

Hence the utmost error in the estimate of the average depth of rainfall over the area is $\tau/2$ inches ........(I)

The above method is rather too laborious to be practical use except when high accuracy is required. It assumes the existence of a sufficient number of raingauge stations distributed over the region to enable the drawing of isohyets at required intervals. Any maldistribution like too many raingauges in one part of the area and comparative scarcity in another will not effect the accuracy. Hence no particular design in the distribution of the stations is necessary except that required for fixing the isohyets.

Let us now allot to each $D_m$ a certain number $n_m$ of rain-recording stations such that $n_m$ is proportional to $a_m$. The estimated rain amount be

$$\sum_{m=1}^{n} R'_m n_m, \text{ where } R'_m = \frac{1}{n_m} \sum_{p=1}^{n} R_p.$$

Thus an estimate of the average rainfall of the region based on N ($\Sigma\, n_m$) observations is the average of the rain amounts recorded at all the stations in the area, *viz.*,

$$\frac{1}{N} \Sigma R,$$

where R is the rainfall recorded at any of the stations.

By proper choice of the unit of area, it is possible to set $a_m = n_m$.

Since now, $|R - R'_m| \leqslant \tau \ldots R, R'_m \subset D_m$

$$\text{The error} = \sum_{m=1}^{n} \int_{D_m} (R - R'_m)\,dA \leqslant \tau A.$$

$\therefore$ the error in the average $\leqslant \tau$ .......... (II).

That is, if the raingauges are distributed such that each $D_m$ has an $n_m$ of them, $n_m$ being proportional to $a_m$, than the average rainfall

of species and their hybrids gives a background for accomplishing the transfer of a desirable gene or gene-complex from one species to another, preserving the genom of the latter plant. At this stage cytogenetic work ends and the plant-breeding work begins, using the derived form for transferring the new characteristic to such economic varieties, as desired, for different localities and purposes.

A synthetic species alike to *N. tabacum* was produced by me[6,7] in 1936, using two genoms of *N. silvestris*, and two genoms of *N. tomentosiformis* and similar work has been done by Greenleaf[9] in 1941. Stebbins[8] gives the data, but gives priority to Greenleaf, however. This data, and observations in other *Nicotiana* species hybrids, done by me, show the chromosome homologies in the different species. In *glutinosa* × *silvestris* 1-5 bivalents, in *glutinosa* × *tomentosiformis* 5-8 bivalents and in *glutinosa* × *tabacum* 2-6 bivalents are formed frequently. This behaviour suggests possibilities in breeding by transfer of a segment or entire chromosome from one species to another.

Even Gerstel's data are in favour of this conception, as he suggests possibility of a exchange transfer of an entire chromosome.

From plant-breeding point of view, substitutions of an entire chromosome pair from a wild into a cultivated species is not desiable, as the entire chromosome can contribute undesirable characters. In the present work, *N. tabacum* var *virii* enabled me to produce by hybridisation and selection, virus-resistant plants having good yield and excellent quality. It is doubtful if such quality can be obtained if an entire chromosome pair had been substituted.

From evolutionary and plant breeding point of view, chromosome substitution has restricted possibilities in production of new forms, as compared to possibilities by a transfer of a gene or small group of genes. The genomic background of a species is less affected by the transfer of a small portion of a chromosome. In addition, fertility of the new hybrid is not much affected. In plant breeding, such forms can be used to transfer the new character to other varieties. I shall not be surprised if in a short time all cultivated tobacco varieties are corrected in this respect, *i.e.*, all of them made resistant to the common tobacco mosaic virus with the use of *N. t. virii*.

This paper is to show once more that cytogenetics both stimulates the development of other biological sciences and gives a real background for the development of applied sciences—in this case contributing to the production of newer and better crop plant.

Thanks are due to R. Georgieva and D. Tzikov for help throughout this work.

1. Kostoff, D., *Phytopath. Zeitschr.*, 1937, **10,** 578-93. 2. Kostoff, D., "Resistant tobacco varieties against mosaic virus experimentally produced, Sofia", 1944. 3. Ternovsky, M., *Zeitschr. f. Zuchtung, Reihe A. Pflanzenzuchtung*, 1935, **20,** 268-89. 4. Gerstel, D. U., *Genetics*, 1946, **31,** 42-427. 5. Muntzing, A., *Hereditas*, 1935, **20,** 251-72. 6. Kostoff, D., *Curr. Sci.*, 1936, **4,** 872. 7. Kostoff, D., *Compt. Rend. (Doklady) Acad. Sci., USSR*, 1938, **18,** 7. 8. Stebbins, G. L., *Advance in Genetics*, 1947, **1,** 403-29. 9. Greenleaf, W. H., *Genetics*, 1941, **26,** 301-24. 10. Kostoff, D., *Cytogenetics of the Genus Nicotiana, Sofia*, 1941-43, **1-28,** 1-1071.

## FELLOWSHIPS TO FRENCH GRADUATES

WITH a view to strengthening the cultural bonds between India and France, the Ministry of Education, Government of India, propose to award nine Fellowships to suitable French graduates for research work and teaching in Indian Universities in 1949. This is in response to the interest shown by the French Government in cultivating the study of the Indian languages and literature amongst the French people.

Last year the French Government awarded nine scholarships to Indian students. They have awarded another ten scholarships in the current year. They have also sent out three French students to India to study Hindi and another student is coming shortly to study Sanskrit literature.

The value of the Fellowships to be granted by the Government of India has been fixed at Rs. 500 per month for a period of two years plus the cost of second-class return passage. Each Fellow would be expected to undertake teaching in the French language and literature at an Indian University in addition to his own work. The actual number of Fellowships granted will depend on the response from the Universities.

In a letter addressed to the Vice-Chancellors of Universites in India, the Ministry of Education have proposed that the cost of each Fellowship may be shared equally between the Government of India and the University at which the Fellow will be placed. By this means, the University will secure an efficient tutor of French language and literature at a cost of about Rs. 250 per month and half the share of the passage.

There has been a rapid development of our foreign contacts and there is a growing demand in Indian Universities for instruction in foreign languages. It may even be possible to secure as Fellows French students competent to give instruction in French as well as other European languages.

From the cultural view-point also, it is felt that India should adopt a wider outlook and should take all possible steps to encourage the promotion of reciprocal cultural exchanges with foreign countries.

The Government of India have asked each University to let them know if it would be willing to accept one or two Fellows and would be prepared to meet half the expenses as proposed by the Government.

# ON ESTIMATING THE AVERAGE DEPTH OF RAINFALL OVER AN AREA AND THE DISTRIBUTION OF RAINGAUGES

K. S. RAMAMURTI

(*Poona*)

## INTRODUCTION

THE average depth of rainfall over an area is usually calculated as the arithmetic mean of the rainfall amounts recorded at all the raingauge stations in it. The India Meteorological Department is adopting this method in arriving at the mean rainfall figures for the various subdivisions of India.

Satakopan and Vittal Sarma[1] have made a study of the optimum number of rain-recording stations required in catchments for estimating run-off. They have also calculated the average rainfall as the arithmetic mean of the rainfall amounts recorded at various stations in the catchment, though they refer to the unsatisfactory distribution of the raingauges over the area. In addition they have assumed that the variability (s.e. is considered) of the average to be $\sigma/\sqrt{n}$, where $\sigma$ is the standard deviation and $n$ the number of observations. It has been pointed out that this assumption holds good for distributions which are not highly skew.

The average depth estimated as indicated above will be subject to an error even when the raingauges are evenly distributed; but will give an altogether erroneous idea of the rain amount if the raingauge stations are badly distributed, *e.g.*, majority of the gauges are located in the region with more rainfall while a few only are in the region with less rainfall or *vice versa*.

In this note the distribution of the rain-recording stations necessary for calculating the average rainfall over an area as the arithmetic mean of the observed values is discussed. The maximum error in the estimate is also studied under some simplifying assumptions regarding the rain-field. A general suggestion regarding the distribution of rain-recording stations over the country is made.

## DISCUSSION

The variation of rainfall in space is a complex phenomenon. In the following discussion continuity of rainfall in space has been assumed. It may be mentioned that spatial continuity could be assumed in cases when rainfall is widespread, or when considering the monthly, seasonal, etc., total amounts. Drawing of isohyets is based on this assumption.

The total rain amount over an area is $\int_D R\,dA$

where R is the rainfall at any location in the region D and $dA$ is an element of area around the location. The integration is taken over the whole region D. The mean depth of rain water is $\int_D R\,dA / \int_D dA$.

Let C be the boundary of D. Let the number of raingauges in the area be sufficient to draw isohyets at an interval of $\tau$ and let these isohyets divide D into sub-regions $D_1, D_2 \ldots D_n$ with areas $a_1, a_2, \ldots a_n$. Here $D_p$ includes all the sub-regions in D lying between the same isohyets.

Then $$\int_D R\,dA = \sum_{m=1}^{n} \int_{D_m} R\,dA$$

Let $R_m = \frac{1}{2}(R_{max} + R_{min})$, where $R_{max}, R_{min} \subset D_m$. That is, $R_m$ is the average of the rainfalls at the two bounding isohyets.

The total rain amount may now be estimated as

$\sum_{m=1}^{n} R_m a_m$ and the error in this estimate is

$$\sum_{m=1}^{n} \int_{D_m} (R - R_m)\,dA \ldots . \because R_m a_m = \int_{D_m} R_m\,dA$$

$$|R - R_m| \leqslant \tau/2, \ldots . R, R_m \subset D_m$$

$$\therefore \text{ the error} \leqslant \tau/2 \sum_{m=1}^{n} \int_{D_m} dA$$

$\leqslant \tau/2 \cdot A$, where A is the total area.

Hence the utmost error in the estimate of the average depth of rainfall over the area is $\tau/2$ inches........(I)

The above method is rather too laborious to be practical use except when high accuracy is required. It assumes the existence of a sufficient number of raingauge stations distributed over the region to enable the drawing of isohyets at required intervals. Any mal-distribution like too many raingauges in one part of the area and comparative scarcity in another will not effect the accuracy. Hence no particular design in the distribution of the stations is necessary except that required for fixing the isohyets.

Let us now allot to each $D_m$ a certain number $n_m$ of rain-recording stations such that $n_m$ is proportional to $a_m$. The estimated rain amount be

$$\sum_{m=1}^{n} R'_m n_m, \text{ where } R'_m = \frac{1}{n_m} \sum_{p=1}^{n} R_p.$$

Thus an estimate of the average rainfall of the region based on N ($\Sigma n_m$) observations is the average of the rain amounts recorded at all the stations in the area, *viz.*,

$$\frac{1}{N} \Sigma R,$$

where R is the rainfall recorded at any of the stations.

By proper choice of the unit of area, it is possible to set $a_m = n_m$.

Since now, $|R - R'_m| \leqslant \tau \ldots . R, R'_m \subset D_m$

$$\text{The error} = \sum_{m=1}^{n} \int_{D_m} (R - R'_m)\,dA \leqslant \tau A.$$

$\therefore$ the error in the average $\leqslant \tau$ ..........(II).

That is, if the raingauges are distributed such that each $D_m$ has an $n_m$ of them, $n_m$ being proportional to $a_m$, than the average rainfall

derived from these N stations will represent the mean rainfall over the region, with a maximum error given by $\tau$. On a fairly even terrain, where the distribution of rainfall is more smooth and has less variability, an even distribution of the raingauges, say, at equal distances along latitudes and longitudes will in general ensure that the number of raingauges in $D_m$ is proportional to $a_m$ for sufficiently large $\tau$. *Therefore an even distribution of the stations over a fairly even region is a prerequisite for estimating the average rainfall as the arithmetic mean of the rainfall recorded at a number of locations in the area.* A non-uniform distribution will give a higher weightage to the rainfall recorded in the regions with denser distribution of raingauges and less weightage to that in regions with sparser distribution.

The distribution of raingauges in any part of India is at present far from even. Hence the arithmetic mean of the falls recorded at these stations may not give a correct estimate of the rainfall over the area on most occasions. The Central Board of Irrigation in India has recently recommended a distribution of one gauge per square of 25 miles, *i.e.*, per 625 sq. miles.[2] These when distributed one for every 25 miles square may prove to be sufficient for all climatological purposes.

The normal gradient of isohyets becomes steep in the hilly regions due to the influence of orography on rainfall. That is, the number of isohyets at interval $\tau$ that cut across a unit area increases over this region. Therefore to fix up the isohyets at the same interval we require a denser distribution of rain-recording stations over these regions. But, while working out the average rainfall over any area of which these regions with denser distribution form a part, allowance has to be made for the density. For example, if the distribution over a part of the area is $k$ times as dense as the general distribution over the plain country, the total amount as well as the number of the stations have to be weighted by $1/k$ before combining these with the totals of the rest of the rainfall observations.

Having distributed the raingauges as stated above let us estimate the error in the average rainfall over an even region in terms of $\rho$, the range of rainfall, and N the number of raingauges in the region. For this purpose, the rainfield is assumed uni-modal with concentric circular isohyets.* Let N ($n \times n$) unit square cells with one raingauge in each cover the field completely. Let $\rho$ be the total range of rainfall in the field. The range will vary from cell to cell. The mean range is easily seen to be $2\rho/n$. If $R_{p,q}$ is the rainfall amount measured at the station in the $p$th row and $q$ th column and $\tau_{p,q}$ the range in the cell enclosing the station, the error in the estimate of the total quantity in the cell $(p, q)$ is

$$\int_{(p,q)} R\,dA - R_{p,q} \times 1$$

$$= \int_{(p,q)} (R - R_{p,q})\,dA$$

$\because$ cell $(p, q)$ has unit area.

$$< \tau_{p,q} \int_{(p,q)} dA$$

$$< \tau_{p,q} \times 1$$

Hence the error in the estimate of total amount over the whole field

$$< \sum_{p=1}^{n} \sum_{q=1}^{n} \tau_{p,q} \times 1$$

$$\leqslant \frac{2\rho}{n} n^2.$$

Therefore the error in the mean is

$$\leqslant \frac{2\rho}{n}$$

$\because$ $n^2 = N$ is the total area,

$$\leqslant \frac{2\rho}{\sqrt{N}}.$$

The conditions set forth have all been used for arriving at the final error. Hence these conditions are essential for assuming the error to be $2\rho/\sqrt{N}$.

## Concluding Remarks

But the spatial variation of rainfall is much more complex and particularly so in river catchments where orography makes the distribution even non-uni-modal. A purely theoretical analysis of such cases is therefore more involved. In general, the depth of rainfall varies inversely with the area.[3] The author understands from Mr. V. Satakopan that he is studying the distribution of rainfall in space and that he also finds that both spatial and temporal distributions approximate to L-shaped curves. That is, the sub-regions $D_m$ are such that $a_m$ is a monotonic sequence. The error in the estimate of average rainfall is being studied under this distribution law.

The author is thankful to Mr. V. Satakopan for helpful criticism.

1. V. Satakopan and V. Vittal Sarma, 1947, "Determination of the Optimum Number of Rain-recording Stations Required in Catchments for Estimating Run-off"—Paper submitted to the Research Committee meeting of the Central Board of Irrigation, held in July 1947. 2. V. V. Sohoni, Hydrometeorology in India, *Jour. Sci. and Indus. Res.*, 1948, **7**, 5. p 222–227. 3. Hydrology, 1942, Physics of the Earth IX, McGraw-Hill Book Company, New York and London.

*Note*—The cost of printing this contribution has been defrayed by a generous grant from the Rockefeller Foundation for the publication of results of scientific work made to us through the kindness of the National Institute of Sciences, India—*Ed.*

* This type of field will be approximately realised when considering the rainfall on a day when a storm is centred in the region.

# ENDOWMENTS OF NUFFIELD FOUNDATION

TEN models of a new type of reflecting microscope, designed by Dr. C. R. Burch of Bristol University, have been built with the aid of a grant made by the Nuffield Foundation. This interesting fact was recently published in the *British Medical Journal.* The new appliance will, in the main, be used for research on carcinogenetic substances. It differs from the old type of refraction microscope and refracting ultra-violet ray microscope, in that it has two aspheric surfaces instead of one.

Many millions of pounds have already been given by Lord Nuffield for philanthropic and scientific purposes, including a £ 2,000,000 (Rs. 2·66 crores) grant to Oxford University. In all, Lord Nuffield has made gifts totalling about £16,000,000 (Rs. 21·30 crores). The most important of these is perhaps the foundation which bears his name, the Nuffield foundation, which was established at the beginning of 1943 and endowed with Ordinary Stock Units of Morris Motors Ltd., of which Lord Nuffield is the founder, to the value of £ 10,000,000 (Rs. 13·31 crores).

### Three Main Objects

The three main objects of the Foundation are:

(*a*) The advancement of health and the prevention and relief of sickness ...in particular.... by medical research and teaching and by the organisation and development of medical and health services.

(*b*) The advancement of social well-being, in particular, by scientific research and the organisation, development and improvement of technical and commercial education including the training of teachers and provision of scholarships and prizes.

(*c*) The care and comfort of the aged poor.

It might be assumed that such foundations would be superfluous in Britain with her national health service and highly developed system of education, but as all these things have to be paid for out of the taxpayer's pocket, the money required for research purposes has to be handled very carefully. At times scientific research work meets with failure or gives results which have no immediate practical value. The financial risks involved in such work cannot be borne by the State and it is here that the Nuffield Foundation steps in by assisting prudent pioneer work, and at the same time working hand in hand with the Government departments concerned.

### Study of Rheumatism

During the first four years of its existence, the Foundation made grants totalling £ 1,182,820 (Rs. 1·57 crores). One of the main branches of medical research to benefit from the Nuffield Foundation was the study of chronic rheumatism. Statistics published by the Ministry of Health for the year 1922 showed that rheumatism was responsible for one-sixth of the cases of sickness arising among insured workers, that £ 2,000,000 (Rs. 2·66 crores) had to be paid out in sickness benefit and that there was a loss of 3,000,000 weeks of working time.

The new national health insurance, which covers the whole of Britain, estimates that one-third of the payments made will be in respect of chronic rheumatism. When the Ministry of Health recommended the setting up of the first Rheumatism Centre in 1945, the Foundation made a grant of £100,000 (Rs. 13·31 lakhs) to the University of Manchester for the establishment of a diagnostic and research centre at the Manchester Royal Infirmary.

A similar sum was given to the Institute of Child Health set up in 1944 by the University of London. Durham and Glasgow Universities each received £ 40,000 (Rs. 5·32 lakhs). Manchester University received £ 70,000 (Rs. 9·31 lakhs) for industrial health research. Durham specialised mainly in research on the health of coal-mining and ship-building workers. Finally, £ 150,000 (Rs. 19·96 lakhs) was paid out to encourage suitable persons to undertake an academic career in dentistry.

Natural Sciences, too, have not been forgotten; Birmingham and Glasgow Universities have received grants for research purposes in nuclear physics and radiation, while Birkbeck College, London, has set up a research laboratory on bio-molecular studies under Professor J. D. Bernal, F.R.S.

### Travelling Fellowships

In all £ 35,000 (Rs. 4·65 lakhs) has been granted by the Foundation to the Institution of Mining and Metallurgy, to be devoted to a scheme of travelling fellowships and scholarships for teachers and, £40,000 (Rs. 5·32 lakhs) to a scheme of research. Similar amounts have been given to university laboratories and other scientific institutions for improvement of their equipment.

We cannot go into detail here regarding all the various branches of research encouraged by the Nuffield Foundation. It suffices to say that studies in the sphere of social science, political and economic planning, population problems, statistics and the law will all be encouraged, to say nothing of the generous grants devoted to the improvement of education and the accommodation and care of old people.

# NEW LAMPS FOR OLD*

THE incandescent filament lamp which has held the field of electrical illumination for more than half a century seems to be confronted now by the discharge lamp, a rival gradually appearing above the horizon. The mercury and the sodium discharge lamps on account of their low power consumption and efficient lighting, have come to be installed on highways and public places as well as in shop windows. These together with the well established 'neon' advertisement signs which are also 'lamps' of the discharge type, add considerably to the conveniences and attraction of a modern city.

An interesting development of the mercury vapour discharge lamp which is very recent in origin is to be seen in the nightly demonstration almost in all the towns nowadays of what was once but a laboratory curiosity. The fluorescent property of a class of solid materials has been harnessed by the utilization of the large amount of ultra-violet light available in the low pressure type of mercury discharge lamp. This excites fluorescence of 'day-light' or other suitable colour throughout the long track of light in the lamp-tube lined with fluorescent powders. The popular demand for this type of lamp indoors in home, shop and in industrial occupations is growing.

In its scientific and technical applications however, the progress made by the mercury lamp has been slower. As a convenient source of monochromatic radiations in the visible as well as in the ultra-violet regions of the spectrum in a large number of scientific investigations it has stood for more than thirty years as the best in the field and is in no danger of being displaced. Indeed, with the development of many new types, it may find increasing favour by the socientific workers. The Raman Effect owes its discovery to this lamp. Yet, for other purposes, as an illuminant in photographic and projection work it has still to make a headway. Mr. Bourne's book under notice, as its title shows, deals with these applications of the discharge lamps, in particular with the mercury vapour class and a perusal of the last chapter will convince any sceptic that the mercury arc has a great many advantages over the incandescent filament and the carbon arc now in common use.

The author after describing the characteristics of the incandescent filament and the carbon arc lamps as light sources for photographic and projection purposes in the first four chapters of the book, devotes the rest of the nine chapters covering eighty per cent. of the printed matter, to discharge lamps, various types of mercury arcs naturally receiving most of the attention. The discharge characteristics in mercury vapour under every possible conditions of excitation has been treated in great details. Considerations which enter into the design and construction of lamps of various size and shape to suit either the operational conditions or some specific need have been fully brought out. Thus the effect of variation in pressures and arc loading per unit length on the spectral distribution, luminous efficiency and the voltage-wattage characteristics of the lamps of various types is clearly discussed and the necessary information is given about the composition of the glass or quartz employed for enclosing the arc, the seals, the electrode materials and the general dimensions of the completed lamp in each case. A large number of tables, graphs and photographs scattered throughout the book greatly enhance its value. Ten appendices at the end supply a glossary and definitions of terms used in photography, illumination and photometry, nomenclature for various types of mercury vapour lamps, symbols and expressions used in their design, brightness data for various celestial and terrestrial sources of light, information about the range of the electromagnetic spectrum, the speed of various photographic emulsions, characteristics of exposure meters, etc.

A brief review may be now made of the various types of mercury vapour discharge lamps described in the book.

*M A:* This type is a glass enclosed linear source working at a pressure of one atmosphere. With a loading of 20-30 watts and a potential gradient of 5-10 volts per cm. its luminous efficiency is 40/60 lumens per watt while the brightness of the source is 150 candles per unit area of the surface during a life of 1500 hours. The lamp finds extensive application in street and industrial lighting.

*M B:* The M B type which works at much higher pressures of 5-10 atmospheres in a quartz tube has the same luminous efficiency and life as the M A type, but on account of the higher pressure employed, higher arc loading is possible, resulting in a brightness per unit area which is 6 to 7 times greater than the M A type.

*M E and M D:* These two types work at a still higher pressure in quartz—the former at 20-40 and the latter at 75-100 atmospheres needing a forced cooling by air or water. The M E type lamps which are made in compact form in a spherical enclosure, are very convenient concentrated sources, giving a high brightness, namely 10,000 candles per square cm. They have a fairly good life of 500 hours. Both these lamps have about the same arc loading of 400 to 1000 watts per cm. but the M E type being more compact it has a greater brightness per unit area of the surface. The luminous efficiency of the water cooled M D arc is however 60-65 lumens per watt, being 50 per cent. above any other type. However owing to the rapid devitrification of quartz on account of the high dissipation of power, the water cooled lamp has a life of 25-100 hours only and it needs a special high voltage and water supply.

In an experimental M D type lamp running at 1400 watts loading and 805 volts per cm. and taking a current of 2·1 amperes, a brightness of 180,000 candles, equal to that of the sun and probably the highest for a terrestrial

---

* *Discharge Lamps for Photography and Projection.* By H. K. Bourne. (Chapman & Hall, London), 1948. Pp. 424 + xv. 36*sh.*

source, has been recorded. The lamp worked at 200 atmospheres and its temperature was estimated at 89,000° K. For the reason given above however, the life of such a lamp is only a matter of few minutes. The spectrum of this source shows considerably broadened lines with a continuous background.

The compact source M E type of lamp's high brightness, long life and useful optical characteristics makes it suitable for a variety of purposes. It is thus an admirable substitute for the carbon arc and being sealed in an enclosure is much cleaner to work with. These lamps are made in wattages varying from 100 watts to 25 kilowatts.

For use in the 16 mm. and other substandard film projectors as well as in lantern slides and episcope projectors, the M E type mercury arcs give satisfactory performance. With the same power consumption as an incandescent filament lamp and at the same time reducing by half the amount of heating associated with it, a 250 or 500 watts lamp in a projector increases the screen illumination from 100-250 lumens to 250-1000 lumens per watt. For a high power 35 mm. standard cine projector the high pressure mercury lamp could be used, but compared with a modern high intensity carbon arc the chief drawback is its very short life of 25 hours. Colour rendering is also rather poor with these lamps.

*M C F:* This is the now common type of fluorescent lamp, the 40 and 80 watts units having a glass tube-length of 4 and 5 feet respectively. The lamp differs from all the rest in that it works at a very low mercury vapour pressure of 0·015 mm. Its unusual length as an ordinary illuminant is a consequence of the very low potential gradient of 1 volt per cm. necessary to maintain the tube at a low temperature not exceeding 60° C., for it is at about this optimum temperature that the intensity of the fluorescent light from the powders is at a maximum. The lamp through the agency of the ultra-violet light at the wavelength 2537 A raises its original luminous efficiency from 5 to 35 lumens per watt, which is nearly three times greater than an incandescent filament light. This combined with a life which is also three times greater, (3,000 hours) more than compensates the high initial cost of the lamp. For home lighting either in the cool 'day-light' form or in the 'warm white' form, it would be therefore cheaper to have this type of lights which are now available in wattages varying from 6 to 80. Thus a 15 watt fluorescent lamp may be substituted for an ordinary 40 watt incandescent filament lamp, the total number of lumens obtained in each case being $15 \times 35 = 525$ and $12 \times 40 = 480$, respectively.

As sources of high actinic value, the M A, M B as well as the M C F mercury lamps have proved useful and economical in all types of photographic and photomechanical work such as copying, printing and enlarging and for photographic, movie and television studios.

For photography under poor illumination and for high speed photography in the study of motion, light-flashes of high intensity and durations ranging from a few milliseconds to a few microseconds, according to the motion of the object and speed of the camera shutter, are necessary. The old magnesium burning technique was replaced in 1930 by the American photoflash bulbs containing thin aluminium foil and oxygen. Such lamps which run on dry cells are useful only once, but they are still used. They give a total light output of the order of a million lumens while the least duration of the flash is 5 milliseconds above the half peak value.

The advantages of an electric discharge flash-lamp over the last one are that it could be repeatedly used while the intensity of light as well as the duration of the flash and the interval between successive flashes could be all conveniently controlled by suitably changing the current conditions of one of the high pressure type of mercury lamp. Synchronisation with the shutter speed is also easily obtained. A further advance in flash photography has been however made by the stroboscopic discharge lamps which give flashes of 10-100 microseconds duration through a condenser discharge in mercury vapour or in one of the rare gases.

With a wealth of information given only in its bare outline here, it would be hardly necessary to add that this treatise on discharge lamps would be eagerly sought for by the technical reader who wants to know any thing about the mercury vapour lamp—a lamp more wonderful than the Alladin's.

B. K. VAIDYA.

---

# TONUS IN UNSTRIATED MUSCLE

INDERJIT SINGH AND SUNITA INDERJIT SINGH

*(From the Physiological Laboratory, Medical College, Agra)*

TONUS in unstriated muscle has been variously explained. It has been ascribed to a catch mechanism[1,2] or to increase in viscosity.[3,4,5,6]

There are two kinds of tone[7]. During one the oxygen consumption increases[8] and during the other it decreases.[8,9] Similarly there are two kinds of inhibition, during one the oxygen consumption increases and during the other it decreases.[8] Correspondingly it has been found that as a result of asphyxia or treatment with cyanide, tone may increase or decrease.[10,11,12,13]

The asphyxial contraction is decreased by oxygen as well as by glucose.[10,14] The action of glucose is antagonised by iodoacetic acid. Thus energy is required to keep the muscle elongated. The normal contractions of unstriated muscle are produced on a background of inhibition. This is also shown by the action of iodoacetic acid which abolishes this inhibition and causes the muscle to contract. The

contractions of unstriated muscle are then produced on a background of tonus. The asphyxial contraction may provisionally be termed "alactic" tone in contrast to the other tone which is increased by oxygen and glucose —"lactic" tone. It cannot however definitely be said that the former tone only develops when lactic acid production fails or that the latter tone derives its energy only from the production of lactic acid.

When the asphyxial contraction has maximally developed, the muscle still responds to electric current, potassium and acetylcholine, through inhibition by adrenaline, cannot be produced. This shows that the asphyxial contraction is not due to depletion of the entire energy reserves of the muscle.

The inhibitory action of glucose on the asphyxial contraction is temporary. It causes a fundamental change in the properties of the muscle. In its absence, oxygen inhibits the asphyxial contraction, but in its presence it has the opposite action. Thus if glucose is added when the asphyxial tension is rising, after a short period of inhibition, the tension may continue to rise and oxygen now further increases the tension. If the muscle is now asphyxiated, the tension built by the alactic mechanism is lost by the lactic mechanism during asphyxiation. The taking-over by the lactic from the alactic mechanism may be immediate, in which case the inhibitory action of glucose is not apparent.

The chief properties of the asphyxial contraction are (1) that it does not diminish on exclusion of oxygen or addition of sodium cyanide (1 in 10,000). (2) It is converted into lactic tone by glucose. These two properties are shown by muscle removed freshly from an animal. Such a contraction is produced by stimulation with direct current, potassium, barium, iodide, thiocyanate, acetylcholine, even in the presence of oxygen. The contraction produced by iodoacetic acid also does not diminish on the exclusion of oxygen. This suggests that the "asphyxial" contraction is a normal phenomenon and is the tone by means of which unstriated muscle is able to maintain tension without expenditure of energy.

One characteristic of unstriated muscle is slow relaxation. If the muscle is asphyxiated in the presence of a stimulant such as potassium, the withdrawal of potassium does not cause the muscle to relax, as it does in the presence of oxygen. The muscle now relaxes slowly. The properties of this slow relaxation are identical with those of asphyxial contraction or alactic tone. Such slow relaxation is produced even in the presence of oxygen and we have found cyanide and asphyxia to be the most powerful agents in causing such slow relaxation.

Different muscles are affected differently by asphyxia. In the fowl's gut muscle, the asphyxial contraction is hardly noticeable, but the action of glucose shows that it has passed into the "asphyxial state", even though the muscle is relaxed. In frog's stomach muscle oxygen has inhibitory effect on the asphyxial contraction, but in the dog's stomach muscle the effect is less marked. In the frog's stomach muscle, the action of glucose is less marked than in dog's stomach muscle. The normal tone in unstriated muscle is a mixture of lactic and alactic tones. In some muscles, such as the fowl's gut muscle lactic tone predominates, in dog's stomach muscle the alactic tone predominates.

The above view of tonus in unstriated muscle is supported by the phenomenon of active elongation.[15, 16, 17] In dog's stomach muscle, active elongation of a twitch contraction occurs. In frog's stomach muscle active elongation of a normal tonic contraction occurs.

The above experiments show that tonus in unstriated muscle is due to contraction. The question arises, how can production of lactic acid cause relaxation and contraction at the ssme time? It appears that in the muscle there are two different proteins, which are acted upon differently by production of lactic acid, or in the same protein, there are chemical groupings so acted upon. If energy is required to keep the muscle relaxed, the increased oxygen consumption may be due to greater effort at relaxation during contraction. During twitch contraction such an effort might occur, but not during tonic contraction, thus accounting for the difference in oxygen consumption during the two kinds of contraction. It appears that the excitatory and inhibitory processes occur simultaneously, and this perhaps accounts for the existence of a dual nerve supply to unstriated muscle.

---

1. Grutzner, P., *Ergeb. Physiol.*, 1904, **3,** 12. Quoted from C. Lovatt Evans, *General Physiology*, London, 1940 p. 534. 2. Von Uexkull, J., *Zs. Biol.*, 1912, **58,** 305, Quoted from C. Lovatt Evans. *General Physiology*. London, 1940, 534. 3. Bayliss, L. E., *J. Physiol.*, 1928, **65,** 1P. 4. Winton, F. R., *J. Physiol.*, 1930, p. **69, 393**, 5. Bozler, *Zeitsch. F. Vergleich. Physiol.*, 1931, **14, 429**. Quoted from W. H. Howell, *Text Book of Physiology*, London, 1940, 38. 6. Singh, I., *J. Physiol.*, 1938*a*, **91,** 398; 1938*b*, **92,** 62; 1938*c*, **92,** 232; 1938*d*, **94,** 1 *Ind. Journ. Med. Res.*, 1942, **30,** 449; *Proc. Ind. Acad. Sci.*, 1943*a*, **17,** 13; 1943*b*, **17,** 20; 1943*c*, **18,** 53; 1945*a*, **22,** 76; 1945*b*, **82,** 183; *Curr., Sci.*, 1944, **13**, 311. *Proc, Ind. Acad. Sci.*, 1946, **23,** 58. 7. —, *Ibid.*, 1946, **23,** 312. 8. Rao, M. S., and Singh, I., *J. Physiol.*, 1940, **98,** 12. 9. Lovatt Evans, C., 1923, **58,** 22. 10. Singh. I., and Singh, I., *Proc. Ind. Acad. Sci.*, 1948. **27,** 127. 11. —, *Curr. Sci.*, 1947, **16**, 259. 12. —, *J. Physiol.*, 1937, **89,** 8. 13. —. *Proc. Ind. Acad. Sci.*, 1946, **23,** 301. 14. —, *Ibid.*, In the Press. 15. —, *Curr. Sci.*, 1944, **13,** 311. 16. —, Singh, I. and Muthana, M. C., *Proc. Ind. Acad. Sci.*, 1947, **25,** 51. 17. —, *Curr. Sci.*, 1948, **17,** 306, In the Press.

## PROFESSOR P. M. S. BLACKETT, F.R.S., WINS THE NOBEL PRIZE FOR PHYSICS

THE Nobel Prize for Physics has been awarded to Professor P. M. S. Blackett, who was in India recently to advise the Ministry of Defence in the building up of a sound scientific organisation. In 1947, when he attended the Indian Science Congress, an Honorary Doctorate of the University of Delhi was conferred on this British scientist of world fame.

Professor Blackett, who is 51, came into prominence during the summer of last year when he announced a new fundamental law in Physics. Scientific publications all over the world hailed it as one of the major discoveries of the century and compared the new knowledge gained with such achievements as Newton's law of gravitation, the second law of thermodynamics, Faraday's discovery of the correlation of magnetism and electricity, Maxwell's electromagnetic theory of light, and certain aspects of Einstein's theory of relativity.

Professor Blackett's new law furnished an explanation of terrestrial magnetism, establishing a connection for the first time between two fields of Physics—mechanics and electromagnetism.

Throughout World War II, Prof. Blackett was engaged on highly secret research work for the British Government. He had already gained a world-wide reputation for his work on atomic physics, especially on positive electrons and cosmic rays. Early in the war he was attached to the Admiralty, thus renewing his old association with the Navy, for Blackett began life as a sailor.

In 1933, Blackett was elected F.R.S., and became Professor of Physics at Birkbeck College, University of London. He remained there until 1937; at the same time he continued his research, spending part of his time in a laboratory set up on a disused platform of the Underground Station at Holborn. In 1934 he addressed the International Conference of Physics, held at the Royal Institution, describing the results of his research on cosmic rays. His work was recognised in 1940 by the award of the Royal Medal of the Royal Society.

He has been Professor of Physics at Manchester University since 1937 and has received some of the highest honours both in his own country and in the United States.

## FORTHCOMING INTERNATIONAL CONGRESSES

| Date | Year | Sponsored by | Place | Title |
|---|---|---|---|---|
| May .. | 1949 | | | Pan-American Research Conference. |
| May 16–June 3 .. | ,, | ECOSOC | U.S.A. | U. N. Conference on Conservation and Utilisation of Natural Resources. |
| June 14–16 .. | ,, | ICSU | Paris | Committee on Science and its Social Relations. |
| June 20–25 .. | ,, | UNESCO | ,, | International Conference on "Science Abstracting". |
| Aug. 15–19 .. | ,, | | Stockholm (Sweden) | XIIth International Dairy Congress. |
| Sept. 6–10 .. | ,, | IUC | Amsterdam (Holland) | XVth General Conference, International Union of Pure and Applied Chemistry. |
| Sept. 14–16 .. | ,, | ICSU | Copenhagen (Denmark) | General Assembly, International Council of Scientific Unions. |
| Oct. .. | ,, | | Paris | Vth International Congress on Animal Husbandry |
| Oct. .. | ,, | | | VIIth Pacific Science Congress. |
| July 7–Aug. 1 .. | 1950 | | Amsterdam (Holland) | IVth International Congress of Soil Science. |
| | 1950 | IUBS | Stockholm (Sweden) | General Assembly, International Union of Biological Sciences. |
| | 1950 | | Stockholm (Sweden) | VIIth International Botanical Congress. |
| | 1950 | IUHS | Bucarest | International Congress of History of Science. |
| | 1950 | IUBS | Rio de Janeiro | Vth International Congress of Microbiology. |
| Probable July.. | 1950 | | London (England) | IV World Power Conference. |
| Aug. 30–Sept. 6 .. | 1950 | | Cambridge (U.S.A.) | Congress International de Mathematiques. |
| Sept. 8–17 .. | 1951 | IUC | Washington and New York (U.S.A.) | XIIth Congress and XVIth Conference, International Union of Pure and Applied Chemistry. |

By Courtesy of the Principal Scientific Officer, UNESCO Science Co-operation Office for South Asia, University Buildings, Delhi.

# LETTERS TO THE EDITOR



## LAW OF ADDITIVITY OF MAGNETIC SUSCEPTIBILITIES IN HYDRATES

On the basis of Pascal's additivity rule, the susceptibility of a molecular combination is equal to the sum of the susceptibilities of the constituent molecules, provided no deformation takes place in the electronic orbits of the atoms of the combining molecules. It, therefore, follows that the susceptibility of a hydrate is the sum of the susceptibilities of the anhydrous salt and of the molecules of water of crystallisation. The data in this regard is, however, conflicting. Duchemin[1], Zimens and Hedvall[2] and Varadachari[3] have found that the water of crystallisation in some hydrates behaves in an additive fashion, while the work of Raychaudhuri[4] and the earlier investigation of Zimens and Hedvall[5] show that the water of crystallisation does influence the susceptibility of the hydrates.

The authors determined the susceptibilities of a number of (1) anhydrous salts, (2) stable hydrates of these salts, and (3) several hydrates of the same salt containing varying molecules of water of crystallisation, in the solid state. The results, expressed in terms of $-1\times10^{-6}$ c.g.s. units, are given in the following table. Deducting the observed molecular susceptibility of the anhydrous salt from those of the hydrates, values have been calculated for the susceptibility per molecule of water of crystallisation ($\chi H_2O$) and are given in column 3. These values are widely different from the molecular susceptibility of water ($12{\cdot}96\times10^{-6}$) in the case of almost all the hydrates, showing thereby that the hydrates generally do not obey the additivity law. Further in the several hydrates of the same salt, the departure from additivity is greatest in the hydrate containing the least number of molecules of water of crystallisation. Thus the deviations from the law, in all cases, depend upon the number of molecules of water associated with the molecule of the anhydrous salt. A graph drawn for the ratio of the weight of water to the weight of anhydrous salt against the deviation in the molecular susceptibility from additivity per molecule of water of crystallisation in the case of hydrates of several substances also supports the view-point that as the association of water molecules with an anhydrous salt increases the deviation from additivity decreases. These deviations have been explained on the basis of the binding forces between the anhydrous salt and the water molecules. It has been noticed that, in the case of several hydrates of the same salt, the heat of hydration per molecule of water of crystallisation (wherever available) increases as the number of molecules of water of crystallisation decreases. This shows that in hydrates containing least number of molecules of water of crystallisation the energy of binding between water molecules and molecules of the anhydrous salt is greater than in hydrates containing more water molecules. This observation supports the deduction mentioned above.

Raychaudhuri has found a relation between the percentage deviation in susceptibility from

additivity rule and the total heat of hydration of a hydrate. The results obtained by the authors do not substantiate such a relation. They, however, feel that there may be a relation between the deviation from additivity per molecule of water of crystallisation and the heat of hydration per mole.

The detailed discussion and results will soon be published elsewhere.

TABLE I

| Substance | $\chi_m$ | $\chi H_2O$ |
|---|---|---|
| $MgSO_4 \cdot 7H_2O$ .. | 135·50 | 11·96 |
| $MgSO_4 \cdot 5H_2O$ .. | 108·70 | 11·39 |
| $MgSO_4 \cdot H_2O$ .. | 60·78 | 9·02 |
| $MgSO_4$ .. | 51·76 | .. |
| $CaSO_4 \cdot 2H_2O$ .. | 73·02 | 12·27 |
| $CaSO_4 \cdot 2H_2O$ .. | 52·97 | 9·00 |
| $CaSO_4$ .. | 48·47 | .. |
| $ZnSO_4 \cdot 7H_2O$ .. | 137·97 | 11·87 |
| $ZnSO_4 \cdot H_2O$ .. | 63·34 | 8·46 |
| $ZnSO_4$ .. | 54·88 | .. |
| $CdCl_2 \cdot 2H_2O$ .. | 98·68 | 15·43 |
| $CdCl_2$ .. | 67·82 | .. |
| $SrCl_2 \cdot 6H_2O$ .. | 145·31 | 13·54 |
| $SrCl_2$ .. | 64·05 | .. |
| $Ba(ClO_3)_2 \cdot H_2O$ .. | 112·80 | 9·35 |
| $Ba(ClO_3)_2$ .. | 103·45 | .. |
| $Zn_3(PO_4)_2 \cdot 4H_2O$ .. | 165·00 | 10·37 |
| $Zn_3(PO_4)_2$ .. | 123·50 | .. |
| $Na_2B_4O_7 \cdot 10H_2O$ .. | 225·70 | 14·52 |
| $Na_2B_4O_7 \cdot 2H_2O$ .. | 115·33 | 17·41 |
| $Na_2B_4O_7 \cdot H_2O$ .. | 98·69 | 18·19 |
| $Na_2B_4O_7$ .. | 80·50 | .. |
| $BaBr_2 \cdot 2H_2O$ .. | 128·28 | 10·64 |
| $BaBr_2 \cdot H_2O$ .. | 116·60 | 9·61 |
| $BaBr_2$ .. | 106·99 | .. |
| $BaCl_2 \cdot 2H_2O$ .. | 100·16 | 12·79 |
| $BaCl_2$ .. | 74·57 | .. |
| $3CdSO_4 \cdot 8H_2O$ .. | 292·40 | 14·65 |
| $3CdSO_4$ .. | 175·16 | .. |
| $CdBr_2 \cdot 4H_2O$ .. | 148·73 | 15·20 |
| $CdBr_2$ .. | 87·92 | .. |
| $SrBr_2 \cdot 6H_2O$ .. | 164·26 | 10·64 |
| $SrBr_2$ .. | 100·40 | .. |
| $Na_2S_2O_3 \cdot 5H_2O$ .. | 121·62 | 11·83 |
| $Na_2S_2O_3$ .. | 62·48 | .. |
| $K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$ .. | 502·55 | 12·97 |
| $K_2SO_4 \cdot Al_2(SO_4)_3$ .. | 191·05 | .. |
| $Al_2(SO_4)_3 \cdot 18H_2O$ .. | 323·20 | 12·78 |
| $Al_2(SO_4)_3$ .. | 93·05 | .. |

MATA PRASAD, S. S. DHARMATTI., AND N. S. BIRADAR.

Chemical Laboratories,
Royal Institute of Science,
Fort, Bombay.
*August* 21, 1948.

1. Duchemin, E., *Compt. rend.*. 1934, **199,** 571. 2 Zimens and Hedvall, *Trans. Chalmers Univ. Technd (Gothenburg)*, 1942, **9,** 3–26. 3. Varadachari, *Proc. Ind. Acad. Sci.*, 1935, **2A,** 161. 4. Raychaudhuri, *Zeit. F. Phys.*, 1932, **7,** 393. 5. Zimens and Hedvall, *Svensk Kem. Tid.*, 1941, **53,** 12.

## NOTE ON *NYCTOTHERUS COCHLEARIS* NOV. SP., FROM *RANA CURTIPES* JERDON

THE ciliate described here was found in the rectum of the frog, *Rana curtipes* Jerdon, collected in the forest near Castlerock (Goa frontier). Associated with it, other ciliates, such as *Nyctotherus macropharyngeus, Balantidium helenæ* and *Opalina ranarum* were also found. Among these associated ciliates, the individuals of the new species, scanty in number, were conspicuous owing to their large body size and were visible to the naked eye, as small white vescicles. The body form and structure of the ciliate were noted in the living condition. Total preparations made by fixing with Bouin's fluid and staining with Ehrlich's haematoxylin, were used for microscopic study.

NYCTOTHERUS COCHLEARIS NOV. SP.

The body in general outline, is somewhat three-sided. The dorsal surface is deeply convex as found in other species, but the ventral exhibits a protrusion in the middle, by which the third side is formed. The anterior and posterior poles however, are narrow and rounded. The peristomeal region being straight, looks truncated. Thus the body form resembles more or less a spoon with the handle broken off at the truncated part of the ciliate. If the ventral protrusion of the body is taken as an umbo, the form may very well be compared to a shell of a bivalve. Hence the name *cochlearis.* The long and ellipsoidal nucleus, is one of the chief characteristic features of this new species, and is situated immediately over the cytopharynx, having a ratio of length to breadth 6 length. This long nucleus occupies the whole from the anterio-dorsal to the anterio-ventral surface of the body. The chromatin of the nucleus constitutes a number of compactly arranged and deeply stained round bodies. The micronucleus was not noted. The wide oesophagus leads into a narrow and curved cytopharynx, which ends in the middle of the posterior half of the body. The cilia, lining the oesophagus and the cytopharynx, are long and fine. Those on the body are short. A number of small and large vacoules representing perhaps the food-vacuoles, were seen distributed all over the cytoplasm. The contractile vacuole is single, and lies at the posterior end.

*Measurements in microns*:—Body (length × with) range 400-430 × 315-335; Nucleus: (length×width) 235×40; Nuclear

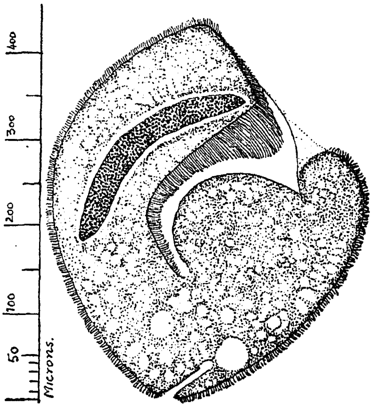



FIG. 1.

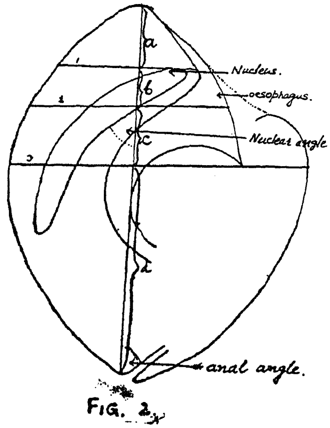



FIG. 2.

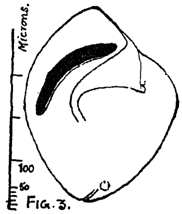



FIG. 3.

*Nyctotherus cochlearis* nov. sp., from *Rana curtipes.*

*N. cochlearis*, showing the proportions of the various lengths as represented by *a*, *b*, *c* and *d*.

*N. cochlearis* nov. sp., as seen under the low power of microscope.

[*a*–the shortest distance between the macronucleus and the anterior extremity ; *b*–the distance between the first line and the second passing through the middle of the œsophagus ; *c*–the distance between the second line and the third passing through the terminal end of the œsophagus ; *d*–the distance between the third line and the posterior extremity of the body. ]

angle—48°; Anal angle—63° ; Oesophagus 115 ; $a=80$ ; $b=60$ ; $c=55$ ; $d=235$.

In the recorded species of *Nyctotherus,* it can clearly be noticed that certain species have a definite tendency to attain exceptionally great lengths. Taking this character into consideration the species of *Nyctotherus* may be classified into three main groups, (1) giant, (2) intermediate and (3) small. Species like *N. magnus, N. vorax* and *N. gigantium,* etc., which range between 300-660 microns, may be included in the first group. Species as *N. ruber, N. macropharyngeus, N. cordiformis hylœ, N. faberi, N. magnus malabarica,* etc., which lie between the giant and the small forms and range from 150-300 microns, come under the second group. The small species such as *N. termitis, N. paludicolœ, N. vulgaris, N. ochoterenai, N. duboisii,* etc., ranging between 90-150 microns, may be placed in the last group.

Obviously, the species under discussion, having large measurements, belongs to the first group, and may be compared with its allied species *N. magnus, N. vorax* and *N. gigantium.* Bezzenberger's *N. magnus* from *R. hexadactyla* (Asia), having a maximum of 660×460 microns, stands as the largest among the giant forms. It has a cytopharynx which is recurved at its end, whereas in the present species, this kind of curvature is absent. The nucleus in our species, is definitely ellipsoidal, but in *N. magnus,* it is flat and irregular. In the other species, namely *N. vorax,* described by Carini, from a Brazilian Girinos, it is ovoidal. *N. cochlearis* differs also from *N. magnus* and *N. vorax,* in the body form, which is kidney-shaped in the former and globular in the latter.

It thus differs from all the giant forms including even *N. gigantium,* which has a bean-shaped nucleus and an ovoidal body. Compared with the species of the other two groups, intermediate and small, our species differs from them, not only in the body measurements but also in the shape and size of the nucleus. For these reasons *N. cochlearis* should be considered a new species.

In conclusion the writer thanks Prof. P. W. Gideon, for providing all facilities during the

COMPARATIVE TABLE

| | *N. magnus* Bezz | *N. vorax* Carini | *N. cochlearis nov. sp.* |
|---|---|---|---|
| Body size .. | 660 × 460 mcr. | 300–450 × 200–250 mcr. | 400-430 × 315–335 mcr. |
| Body shape .. | Kidney-shaped | Globular | spoon-shaped |
| Nucleus size and shape .. | Flat and irregular | 100 × 75 mcr., ovoidal | 235 × 40 ellipsoidal |
| Cytopharynx .. | recurved at end | Funnel-like | Funnel-like |
| Nuclear angle .. | .. | 65° | 48° |
| Anal angle .. | .. | .. | 63° |

course of this work, and Prof. Armando Manezes, for suggesting the Latin name.

Dept. of Zoology, J. C. UTTANGI.
Karnatak College,
Dharwar,
*September* 10, 1948.

1. Bezzenberger, E., 1904. 2. Bhatia, B. L., 1936. 3. Carini, A., 1921, 1929, 1939, 1940.

## CATALYSIS OF THE REACTION BETWEEN VANADATE AND AROMATIC AMINES CATALYSED BY THE OXALATE ION

IT has been previously reported that oxalate catalyses the reaction between dichromate and hydriodic acid[1] and dichromate and hydrobromic acid[2] and dichromate and aromatic amines.[3] Viswanatham and Gopalarao[4] have found that the oxalate ion has a profound accelerating action on the reaction between the vanadic acid and the hydriodic acid. This catalytic influence of the oxalate ion has been utilised by them for the iodimetric estimation of vanadate.[5]

It is now found that oxalate markedly accelerates the reactions of a number of aromatic amines with vanadate also. The phenomenon has been studied by noting the time required for the appearance of the characteristic colour on reaction with vanadate in the presence and absence of oxalate. For example, 0·5 ml. of a decinormal solution of sodium vanadate is taken in a clean beaker and water is added to make the volume 20 ml. and 0·1 ml. of a 0·05% solution of diphenylamine in concentrated sulphuric acid was added and the mixture stirred quickly. A stop-watch was started simultaneously and the time required for the appearance of blue violet colour was noted. In the absence of oxalate it took three minutes for the colour to appear, whereas when one ml. of N/10 oxalic acid was added (under otherwise identical conditions) the colour was immediately produced. The results with other amines experimented with are recorded in the following table.

All substances, (except benzidine), under test are dissolved in concentrated sulphuric acid and a known volume of the solution is treated with a known volume of decinormal vanadate solution and a requisite amount of water is added to bring up the volume of the reaction mixture to a total of 20 ml.

The author is grateful to Prof. G. Gopalarao for his valuable guidance in the work.

Chemical Laboratories, M. NARASIMHASASTRI.
Andhra University,
Waltair,
*September* 21, 1948.

TABLE I

| No. | Substance | Quantity and concl. of test soln. | Quantity of 0·1 N vanadate | Overall concn. of oxalate | Observation | |
|---|---|---|---|---|---|---|
| | | | | | without oxalate | with oxalate |
| 1 | Aniline | 2 ml. of 1% soln. | 2 ml. | $1\times10^{-2}$ N | Light green colour in ten minutes. | Slight green precipitate in 3 minutes. |
| 2 | Dimethyl-aniline | 0·1 ml. of 2·5% soln. | 1 ml. | $1\times10^{-2}$ N | Light orange colour in 30 minutes. | Orange colour in 2½ minutes. |
| 3 | Paratoluidine | 2 ml. of 0·1% soln. | 1 ml | $1\times10^{-2}$ N | No change even in ten minutes. | Reddish brown colour in 5 minutes. |
| 4 | α naphthyl-amine | 1 ml. of 0·1% soln. | 1 ml. | $1\times10^{-2}$ N | Light pink colour after 8 minutes. | Pink colour in ½ minute turning reddish brown in 2 minutes. |
| 5 | Diphenyl-amine | 0·1 ml. of 0·05% soln. | 0·5 ml. | $0{\cdot}5\times10^{-2}$ N | Blue-violet colour in 3 minutes. | Blue violet colour immediately. |
| 6 | Diphenyl-benzidine | 0·1 ml. of ·05% soln. | 0·25 ml. | $0{\cdot}5\times10^{-2}$ N | Light blue violet colour in 1 minute turning more intense in 2 minutes. | Intense blue-violet colour immediately. |
| 7 | Benzidine | 5 ml. of 0·05% soln. in 10% acetic acid | 0·1 ml. | $0{\cdot}5\times10^{-2}$ N | Blue-violet colour immediately. A fine blue violet precipitate forms in 8 minutes which does not settle down even after thirty minutes. | A bulky violet precipitate in 1½ minutes which settles down almost immediately leaving the supernatant liquid colourless. |

1. C. R. Viswanatham and G. Gopalarao, *Curr. Sci.*, 1942, **11**, 102. 2. —, *Ibid.*, 1943, **12**, 186. 3 —, *Ibid.*, 1944, **13**, 47. 4. —, *Ibid.*, 1943, **12**, 229. **5.** C. R. Viswanatham, J. V. S. Ramanjaneyulu and G. Gopalarao, *Proc. Nat. Inst. Sci. India*, 1943, **11**, 333.

## EARTHWORMS AND INSECTS IN RELATION TO SOIL FERTILITY

BESIDES producing general effects, *viz.*, weathering of soil carried above the surface, the earthworms, and insects like termites and ants are known to bring about changes in the organic matter, mineral matter and structure of the

soil thus affecting its fertility. A few workers including Darwin,[1] Griffith,[2] Joachim & Kandiah,[3] Pendleton,[4] & Kalshoven[5] have studied the changes brought about by earth worms and termites selecting individual groups for their investigation but a review of the literature indicated that no comparative study of the changes brought about by them under similar environmental conditions and on the same land has ever been reported so far. The present communication deals with such a comparative study.

The material for this investigation was collected from a plot of land from a garden attached to the residential bungalow of the senior author. The samples were collected in August which recorded the heaviest rain-fall this year in Kanpur. The plot carries an old lemon tree with a trunk which is almost dead; the termite *Odontoterme* sp was found building its nests on this, ants were observed busy building their hills at the base of the same tree and the plot which carried weeds was full of earthworm casts. Samples were carefully collected from the centre of activity of the three organisms along with a composite sample of soil from different places in the plot which is about 1/10th of an acre. The air dried samples were then analysed by the standard methods.

The following table contains the analytical data :—

| Determinations | Control Soil | Earth-worm Casts | Termite Galleries | Ant Hills |
|---|---|---|---|---|
| pH .. | 7·30 | 8·15 | 7·83 | 7·51 |
| % Moisture on air dry soil .. | 2·68 | 2·24 | 2·62 | 2·66 |
| % Loss on ignition | 3·29 | 4·35 | 3·14 | 3·94 |
| % HCl-Insolubles | 81·22 | 81·55 | 79·10 | 81·63 |
| % $Fe_2O_3$ .. | 3·08 | 3·80 | 3·92 | 3·64 |
| % $Al_2O_3$ .. | 6·79 | 4·65 | 6·76 | 7·25 |
| % CaO .. | 1·16 | 1·93 | 1·01 | 1·44 |
| % MgO .. | 0·58 | 0·47 | 0·73 | 0·44 |
| % $K_2O$ .. | 0·059 | 0·145 | 0·754 | 0·674 |
| % $P_2O_5$ .. | 0·093 | 0·139 | 2·75 | 0·133 |
| Total Exch. Bases (M.E.) | 14·81 | 21·51 | 14·48 | 16·83 |
| Exch. CaO „ | 13·10 | 19·00 | 12·30 | 14·80 |
| „ MgO „ | 0·025 | 0·056 | 0·020 | 0·015 |
| „ $K_2O$ „ | 1·68 | 2·45 | 2·16 | 2·01 |
| „ $P_2O_5$ „ | 0·0023 | 0·0043 | 0·0011 | 0·0040 |
| % C .. | 0·536 | 1·980 | 0·576 | 0·880 |
| % N .. | 0·0[illegible]68 | 0·1918 | 0·1022 | 0·1260 |
| % *Organic Matter | 0·922 | 3·299 | 0·990 | 1·513 |
| C/N .. | 6·19 | 10·32 | 5·63 | 6·98 |

* Organic Matter = Organic Carbon × I·72

All the three increased the pH with the greatest shift by the earthworms. This is apparently due to the largest accumulation of lime in worm casts. The biggest loss on ignition of earthworm casts is in keeping with their highest organic matter content. The termite *Odontoterme* sp. active in this soil did not increase the availability of minerals as reported by certain workers.[6] On the contrary it decreased the exchangeable bases with a serious decrease in lime and phosphorus. Similar decrease was recorded by Griffith[2] in Uganda and by Joachim & Kandaih[3] in Ceylon. Ants though second best in increasing the availability of minerals are much inferior to earthworms which increased the availability of minerals to considerable extent.

The Organic matter is increased nearly three and half times by the earthworms, one and half times by the ants with no increase by the termites. The availability of nitrogen in these soils is under investigation. On the whole of the three organisms studied, earhworms helped most in increasing the fertility of the soil followed by ants.

*Odontoterme* was of no consequence either in raising the organic matter status of the soil or in increasing the availability of minerals.

The details of the investigation will be published elsewhere.

J. G. Shrikhande.
A. N. Pathak.
Chemistry Section,
Government Agricultural College,
Kanpur,
*September* 21, 1948.

1. *Vegetable Mould and Earthworms*, 1881. 2. *E. Afr. agric. Jour.*, 1938, **4**, 70. 3. *Trop. Agriculturist*, 1940, **95**, 333. 4. *Thai. Sci. Bull. Dept. Sci., Mins. of Econ. Affairs.* 5. *Tectona*, 1941, **34**, 568. 6. *Nigerian Forester*, 1940, **1**, 8.

## DIPHTHERIA TOXIN IN SUBMERGED CULTURE WITH AERIATION

Jennings and Linton[1] obtained vigorous growth of *V. Choleræ* by utilisation of high percentage of sugar in a dilute broth by uniform and continuous aeration. Application of this principle was tried by us for production of diphtheria toxin. Recently Linggwood and Fenton[2] have published their observations on diphtheria toxin formation in submerged culture obtained by continuous shaking process.

A modification of Pope's medium was used by us for the experiments. Different quantities of glucose and maltose were tried. Park William Eight strain was used. Cultures were kept at 34-35° C. and continuous aeration was carried out by bubbling air through them. Toxin formation was optimum after 72 hrs. On the whole the results we e comparable to those obtained by us in modified Pope's medium by the usual process. Activated charcoal appeared to improve toxin formation to some extent.

Details are under investigations.

Bengal Immunity Lab.
Serum Department.
Calcutta,
Phanindranath Basu.
Diptish Chakraborty.
*September* 24, 1948.

1. *Archives Biochem.*, 1944, **3** & **4**. 2. *Br. J. Exp. Path.*, 1947, **28**, 354.

## INFLUENCE OF SEA WATER ON PROTOZOAL ACTIVITY AND PURIFICATION OF SEWAGE BY THE ACTIVATED SLUDGE PROCESS

IN the course of our investigations on the occurrence, distribution and development of protozoa in the different Activated Sludge Plants ('diffused air' and surface aeration) in India, it was noted that certain species of marine *Vorticella* and *Zoothamnium* predominated in the sludge from the diffused aeration plant at Tuticorin which is operated with sea water due to acute shortage of fresh water.[1] The purification plant at Tuticorin is the only one of its kind in the world in being worked with sea water.[2]

The Tuticorin Activated Sludge Plant was installed in September 1928 to treat the sewage from a population of 3,000 persons at 15 gallons per head, and in recent years it has been dealing with a correspondingly increased volume of sewage as from a population of about 5,000. The purification plant has been functioning very efficiently since the start; the effluent from the settling tank has always appeared brighter and cleaner than the sea water taken into the works for use (*e.g.*, the sea water contained 3·948% total solids and 0·616% organic matter, *i.e.*, loss on ignition, and the corresponding figures for the effluent are 3·936% and 0·584%; the chloride contents of both were just the same). The clotting and clarifying action of the sludge and its settling property are as remarkable as those of activated sludge formed in other aeration tanks operated with fresh-water.

Observations over a period of eight years have shown that the outstanding feature of the activated sludge produced with sea water is the active presence of a large number of certain species of marine *Vorticella* (*Vorticella marina* and other forms) and *Zoothamnium* sp., one ml. of the mixed liquor containing 8,000 to 18,000 active protozoan cells depending upon the concentration of sludge (the other forms of protozoa, mostly small ciliates, in the sludge are relatively few). Two of the commoner species of these *Vorticellids* are shown in Figures 1-3. Figs. 2 and 3 show the distinctive feature of *Zoothamnium, viz.*, the contractile threads from the lateral branches of the colony, unlike in the case of *Carchesium*, are continuous with the thread in the main stalk, causing all of the zooids to contract together.

Studies have shown that when the *Vorticellids* in the above sludge are selectively rendered inactive or killed out (by employing heat or other sterilising agents), the clarification of sewage is adversely affected and eventually stopped; that the rate of clarification is closely dependent on the number of active *Vorticellids* in the medium.

Apart from our observations, there is no record of the occurrence of *Zoothamnium* sp. in any artificial system of sewage purification. It may also be noted that Bhatia has not recorded *Zoothamnium* from Indian waters.[3] *Zoothamnium* sp. has been reported from Niagara River.[4] More recently, certain species of *Zoothamnium* has been noticed in the mouths of the brackish-water fish, *Acentrogobius neilli* (Day) occurring in the Buckingham Canal, Madras, and has also been obtained from the stomach-contents of fishes such as *Therapon jarbua*.[5]

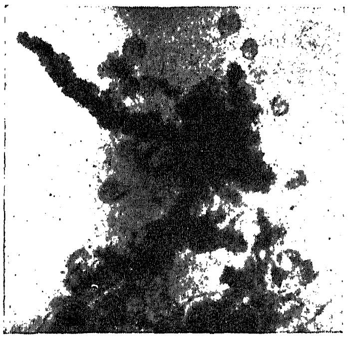


FIG. 1. A cluster of marine species of *Vorticella* × 115.

FIG. 2 A colony of *Zoothamnium* sp. × 115.

FIG. 3 Two individuals of the colonoy of *Zoothamnium* sp. enlarged × 675.

Photomicrographs of the marine species of *Vorticella* and *Zoothamnium* occurring in the Activated Sludge at Tuticorin, where sea water is used for flushing purposes. (Reduced to ¾)

Our thanks are due to Prof. V. Subrahmanyan and Dr. Gilbert J. Fowler for their valuable criticism and for kindly making arrangements for our visits to the Activated Sludge Plant at Tuticorin; to Messrs. Madura Mills Co. Ltd., for kindly sending us samples of activated sludge from time to time and for the facilities placed at our disposal during our visits to Tuticorin; and to Dr. B. R. Seshachar, Central College, Bangalore, for kindly taking the photomicrographs of the protozoa and confirming the identification of the organisms.

Dept. of Biochemistry, Indian Institute of Science, Bangalore,
S. C. PILLAI.
R. RAJAGOPALAN.

*September* 24, 1948.

1. Pillai, S. C., *Curr. Sci*, 1942, **11**, 437. 2. Private communication from Dr. Gilbert J. Fowler. formerly Representative of Messrs. Activated Sludge Ltd. in India and the East. 3. Bhatia, B. L., "The Fauna of British India, including Ceylon and Burma: Protozoa; Ciliophora," 1936, p. 398, Taylor and Francis, Ltd., 4. Ward, H. B., and Whipple, G. C., "Fresh-water Biology," First Edition, 1918, p. 294, John Wiley and Sons, Inc. 5. Jones, S. and Job, T. J., *Curr. Sci.*, 1938, **6**, 558.

## ADDITION PRODUCTS OF ANILS WITH METALLIC CHLORIDES

In course of some synthetic work for the preparation of ethyl acetoacetate-anil, ethyl acetoacetate was reacted with aniline in presence of fused zinc chloride. On working up the reaction product a well-defined crystalline compound was obtained which melted above 240° C. over a wide range and with decomposition. The same product was obtained from ethyl acetoacetate-anil and zinc chloride and was found to be the addition product of the anil and zinc chloride, $C_{12}H_{15}O_2N$, $ZnCl_2$, as on decomposition with sodium carbonate it gave the anil which by Conrad and Limpach's method[1] could be converted to 4-hydroxy-2-methylquinoline. Similar addition products were also obtained from the anil and cadmium and mercuric chlorides. No such addition product of anils appears to be known in literature.

Ethyl $\alpha$-methylacetoacetate-anil gave similar addition products with zinc and mercuric chlorides. Anils from o-anisidine and o- and p-toluidines and ethyl acetoacetate also gave addition products with zinc and cadmium chlorides. Acetophenone-anil and benzaldehyde-anil however, failed to give any addition product with zinc chloride and got hydrolysed yielding aniline-zinc chloride. Hence the formation of addition products with the above metallic halides appears to be the property of anils of $\beta$-ketonic esters only, and would be useful for isolation of anils from an impure mixture and for their characterisation.

Detailed account of the work will be published elsewhere.

Org. Chem. Labs., Royal Institute of Science, Bombay,
V. M. Thakor.
R. C. Shah.
*October* 25, 1948.

1. Conrad and Limpach, *Ber.*, 1887, **20**, 947; Limpach, *Ber.*, 1931, **64**, 969; Hughes and Louis, *J. Proc. Roy. Soc., N. S. Wales*, 1938, **71**, 458; Cavallito and Haskell, *J. Am. Chem. Soc.*, 1944, **66**, 1166.

## AMESITE FROM DEVARNARSIPUR, BHADRAVATHI, MYSORE

In a petrographic collection made by Dr. C. S. Pichamuthu from Devarnarsipur, in the year 1943, occurs an interesting type of rock, which at first sight appears to be an amphibolite. But, on closer examination, it is found to be a chlorite-tourmaline rock. As the chlorite found in this rock appears to be particularly interesting, this mineral has been subjected to a detailed investigation of its optical characters and chemical composition and the main conclusions are recorded below. The chlorite is amesite and the tourmaline is schorlite. The analysis of the amesite[1] is given here and is compared with two others described by Shannon and Pisani.[2]

| | Devarnarsipur | Pisani | Shannon |
|---|---|---|---|
| $SiO_2$ .. | 28·60 | 21·40 | 20·95 |
| $Al_2O_3$ .. | 31·02 | 32·30 | 35·21 |
| $Fe_2O_3$ .. | Nil | Nil | Nil |
| FeO .. | 4·80 | 15·80 | 8·28 |
| MgO .. | 23·44 | 19·90 (MgO + CaO) | 22·88 |
| CaO .. | Nil | | 0·58 |
| MnO .. | 0·37 | .. | traces |
| $H_2O+$ .. | 11·90 | 10·90 ($H_2O+$ and $H_2O-$) | 13·02 |
| $H_2O-$ .. | 0·27 | | 0·23 |
| | 100·40 | 100·30 | 101·15 |

The optical characters of the amesite as compared with that, described by Shannon, from Chester, are as follows:—

| Devarnarsipur | Chester[3] |
|---|---|
| (+) 2V = 0° to 15° 45′ | (+) 2V = 0° |
| Ng = 1·590 | Ng = 1·612 |
| Nm = 1·585 | Nm = Np = 1·597 |
| Np = 1·575 | Ng − Np = ·015 |
| Ng − Np = ·015 | |
| Pleochroic | Colourless |

The Mysore amesite differs from that of Chester in being pleochroic, X=Y= pale green, Z= colourless and showing a character varying from uniaxial to biaxial, with a maximum optic axial angle 2E=26° (calculated to 2V=15° 45′), measured on the Federvo's stage. The silica percentage of the Mysore amesite is higher than that given by Shannon and Pisani. Pisani's formula for amesite, which has been adopted by Winchell, is $H_4Mg_2Al_2SiO_9$.[4] Since silica is known to replace alumina in the structure of these minerals, Pisani's formula for amesite may be modified for Mysore amesite as $H_4\ (Mg, Fe, Mn)_2\ (Si, Al)_3\ O_9$.

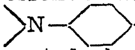
Plotted on the linear diagram proposed by Hammond[5] for chlorite minerals, the Mysore amesite has RO: $SiO_2$ = 296 and $R_2O_3$: $SiO_2$ = 127, and lies in the amesite field.

Dept. of Geology, Central College, Bangalore,
M. G. Chakrapani Naidu.
*October* 18, 1948.

1. Analyst—E. R. Tirumalachar, Chemist, Mysore Geological Department. 2. *American Journal of Science*, 1920, **49**, 96. 3. *Op. cit.* 2 above. 4. *American Mineralogist*, 1936, **21**, 642. 5. *The Mineralogical Magazine*, **25**, No. 167, 454.

## SCHIFF'S BASES OF 4-4′-DIAMINODIPHENYLSULPHIDE

The high antibacterial activity of 4-4′-diaminodiphenyl sulphone and sulphanilamides has led to the belief that the molecular grouping essential for chemotherapeutic activity is the



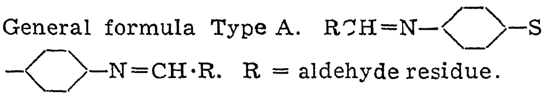
—S—Complex.[1,2] Raiziss, *et al.*[3] reported that, although the therapeutic properties of 4-4′-diaminodiphenylsulphide and its acetyl derivative compared favourably with those of sulphanilamide, their high toxicity

precluded their clinical use. The Schiff's bases of sulphanilamides and N′-substituted sulphanilamides have all been found to be very effective against bacterial infections.[4]

Considering the above facts it was thought worthwhile to synthesise a few typical Schiff's bases (Type A) of 4-4′-diaminodiphenyl sulphide for testing their antibacterial activity. The Schiff's bases (Table I) have been prepared by reacting 4-4′-diaminodiphenyl sulphide with appropriate aldehydes in alcoholic solution and in the presence of condensing agents like zinc chloride. The resulting compounds have been crystallised from alcohol. They have been characterised and listed in Table I.

Table I

General formula Type A.



R = aldehyde residue.

| No. | Aldehyde used | M.P. °C. |
|---|---|---|
| 1 | Benzaldehyde | 176–177 |
| 2 | *m*-Nitrobenzaldehyde | 159–160 |
| 3 | *p*-Dimethylamino benzaldehyde | 231–232 |
| 4 | *p*-Diethylamino benzaldehyde | 155–156 |
| 5 | Salicylaldehyde | 207–208 |
| 6 | Anisaldehyde | 204–205 |
| 7 | Piperonal | 175–176 |
| 8 | Cinnamaldehyde | 178–179 |
| 9 | Furfural | 103–104 |

Details will be published elsewhere.

Organic Chem. Laboratories, M. Raghavan.
Dept. of Pure & App. Chemistry, B. H. Iyer.
Ind. Inst. of Science, P. C. Guha.
Bangalore.
October 26, 1948.

1. Green and Bielchowsky, *Brit. J. Expt. Path.*, 1942, **23**, 13. 2. Fournean, *et al.*, *Compt. rend. Soc. Biol.*, 1938, **127**, 393. 3. Kaiziss, *et al.*, *J. Amer. Chem. Soc*, 1939, **61**, 2763. *cf. Proc. Soc. Expt. Biol. and Med.*, 1938, **39**, 339. 4. Molitor and Robinson, *J. Pharmacol.*, 1939, **65**, 405.

## OXIDATION OF CYSTINE BY NITRIC ACID

Blumenthal and Clarke[1] found that nitric acid oxidises cystine sulphur to sulphuric acid. Evans[2] adopted this method for the estimation of cystine in food materials by conversion to sulphate and estimating the latter as barium sulphate. He, however, observed that with pure cystine only about 62% of the cystine could be recovered as sulphate. Addition of dextrose, soya-bean meal or fish meal along with the cystine increased the recovery to 92-98%. The following note relates to some observations made on the above reaction.

It was first observed that however long the reaction mixture of cystine and nitric acid be heated on the water-bath, the percentage recovery of cystine as sulphate was incomplete. It varied from 62·1% to 66·3%. If after heating the reaction mixture for 24 hours as suggested by Evans, dextrose be added to the reaction mixture and it is further heated for 6-8 hours, 93·6% of the cystine sulphur could be oxidised to sulphate. This experiment showed that incomplete recovery of cystine as sulphate was due to incomplete oxidation and not due to loss of cystine sulphur as oxides of sulphur during the oxidation with nitric acid.

The following table shows the effect of addition of various substances to the cystine prior to oxidation on the conversion of cystine sulphur to sulphate sulphur.

From the results (see table) it can be postulated that during the oxidation of the (-S-S-) linkage of cystine by nitric acid about 1/3 of the cystine is converted to one or more intermediate oxidation products which resist complete oxidation to sulphate by nitric acid alone. Any type of organic matter which can reduce nitric acid to lower oxides of nitrogen if added to the reaction mixture in the beginning of the reaction or at any later stage of the reaction, can catalyse the complete oxidation of these intermediate products to the sulphate stage. The fact that even inorganic substances like copper, zinc or tin which reduce nitric acid to oxides of nitrogen are capable of acting in a way similar to organic materials has to be interpreted to mean that the further oxidation of the intermediate products is brought about by the intervention of the oxides of nitrogen. Further examination of the filtrate from the Barium sulphate precipitation mixture would reveal the nature of the intermediate oxidation products.

The author's thanks are due to Dr. V. Subrahmanyan and Dr. M. R. Aswathanarayana Rao for their interest in the work.

Dept. of Biochemistry, H. S. R. Desikachar.
Indian Institute of Science,
Bangalore,
October 30, 1948.

1. Blumenthal, D., and Clarke, H. T., *Jour. Biol. Chem.*, 1935, **110**, 343. 2. Evans, R. J., *Arch. Biochem.*, 1945, **7**, 439.

*Note.*—0·1 g. samples of cystine were taken for each estimation 2g of lactose, glucose starch, and butter fat were added along with the cystine during the digestion. The amounts of carbon, zinc, copper, and tin added along with the cystine were 1·5 g. in each case.

| | Substances added | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Control | Glucose | Lactose | Starch | Butter fat | Pure carbon | Copper | Tin | Zinc |
| Cystine recovered as sulphate | 63·8% | 95·2% | 94·5% | 95·8% | 95·7% | 96·9% | 95·2% | 96·7% | 97·1% |

## THE EFFECT OF ULTRA-VIOLET LIGHT ON COLLOIDAL GOLD

IN a series of studies on the action of ionizing radiations on colloids, Crowther and Fairbrother[1] came to the conclusion that only positively charged colloids are coagulated by X-rays whereas negatively charged colloids are unaffected. As a cause of this phenomenon they have suggested that it is due to the gradual discharge of the charged colloidal particles by the ionisation produced in solution during the passage of the radiation. Lal and Ganguly[2] made a comprehensive study on the effect of ultra-violet light on colloids and observed that both positively and negatively charged colloids are affected. They assumed that coagulation was due to the photochemical decomposition of the stabilizer. Further evidence of the photochemical nature of the change has been given by Desai and others,[3] Ellinger,[4] and Haines.[5]

In the present communication, a study has been made with colloidal gold prepared in four different ways, *viz*., with formaldehyde, tannic acid, hydrazine hydrate and ethereal solution of phosphorus. These sols were exposed to an "Alpine Sun" ultraviolet lamp for various periods of time and it was found that sols prepared with formaldehyde and hydrazine hydrate only coagulated whereas sols prepared with tannic acid and phosphorus remained unaffected.

Electrical conductivity of these sols were measured with different periods of exposure as recorded in the table below:

TABLE I

Sol prepared with formaldehyde

| Time of exposure | Sp. conductivity × $10^{4}$ |
|---|---|
| 0 hr. | 3·57 mho |
| 3 hrs. | 3·68 mho |
| 8 hrs. | 3·68 mho |
| 16 hrs. (coagulated) | 3·68 mho (coagulated) |

TABLE. II

Sol prepared with hydrazine hydrate

| Time of exposure | Sp. conductivity × $10^{4}$ |
|---|---|
| 0 hr. | 3·65 mho |
| 5 hrs. | 3·65 mho |
| 8 hrs. | 3·57 mho |
| 16 hrs. | 3·55 mho |
| 21 hrs. (coagulated) | 3·55 mho |

It may be seen from the tables that the electrical conductivity of the formaldehyde sol increases with time of exposure whereas that of hydrazine hydrate sol decreases. Carruthers and Norrish[6] have shown that the primary product of photo-decomposition of formaldehyde is formic acid. With the formation of formic acid the hydrogen-ion concentration of the system increases and hence the increase in conductivity. Brav and Cuy[7] have shown that the strength of dilute solutions of hydrazine hydrate decreases rapidly in presence of air. Gilbert[8] has shown that the presence of alkali increases the rate of oxidation and that greater the surface present the greater the oxidizing action. Since colloidal gold is slightly alkaline and a large amount of surface to present in the colloid, the hydrazine hydrate is quickly decomposed into nitrogen and hydrogen as observed by Elgin and Taylor.[9] The decrease in electrical conductivity and the instability of the sol formed with hydrazine hydrate is, thus, explained. Further details will be published later.

My thanks are due to Principal Dr. P. B. Ganguly, D.Sc., F.N.I., for valuable suggestions and guidance and the Govt. of Bihar for the award of a research scholarship.

Physico-Chem. Laboratories,
Patna Science College, B. K. BANERJI.
Patna,
*October* 26, 1948.

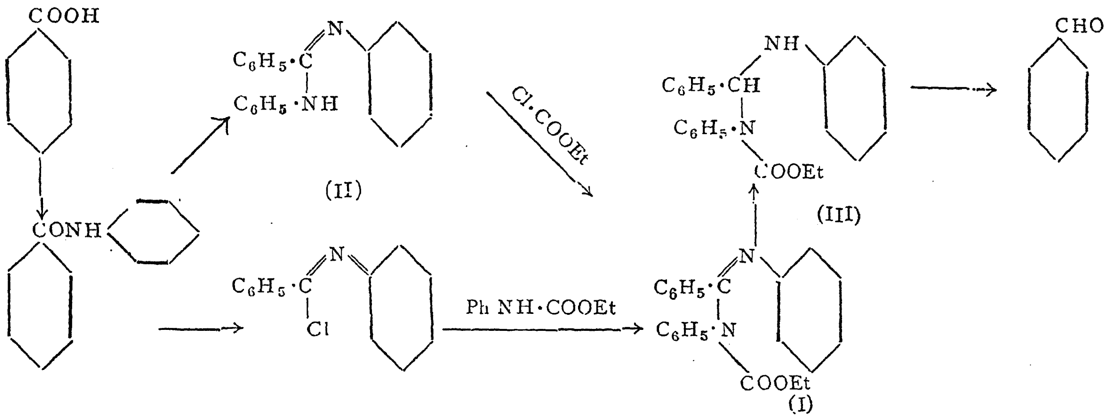
1. *Phil. Mag.*, 1927, **4**, 325; *ibid.*, 1928, **6**, 386. 2. *J. I. C. S.*, 1929, **6**, 547; *ibid.*, 1930, **7**, 513. 3. *Curr. Sci.*, 1934, **3**, 105. 4. *Nature*, 1936, **138**, 1014. 5. *Ibid.*, 1937, **139**, 32. 6. *J. C. S.*, 1936, 1036. 7. *J. A. C. S.*, 1924, **46**, 1786. 8. *Ibid.*, 1929, **51**, 2744. 9. *Ibid.*, 1929, **51**, 2059.

## A NEW METHOD FOR THE CONVERSION OF AROMATIC CARBOXYLIC ACIDS INTO THE CORRESPONDING ALDEHYDES

SHAH AND ICHAPORIA[1] observed that benzanilide imidochloride condensed with urethane to give N-phenyl-N′-carbethoxybenzamidine which suffered ring closure on heating furnishing 4-hydroxy-2-phenylquinazoline, this being a novel synthesis of such quinazoline derivatives. In continuation of this work phenyl urethane was condensed with benzanilide imidochloride. The resulting N : N′-diphenyl-N′-carbethoxybenzamidine (I), which could also be obtained by the reaction of N : N′-diphenylbenzamidine (II) with ethyl chloroformate, however, resisted all attempts at ring-closure.

During the study of the properties of this N-carbethoxybenzamidine (I) it was observed that it could be reduced by aluminium amalgam in moist ether or preferably in ethyl acetate to dihydrobenzamidine (III) which could readily be hydrolysed by cold dilute acid to benzaldehyde. This affords a new method for the conversion of an aromatic carboxylic acid to the corresponding aldehyde.

The following method essentially depends on the reduction of the N-carbethoxybenzamidine to the dihydro compound. Merling[2] observed that amidines derived from hydroaromatic acids can be reduced to diphenylmethylenediamine bases which on hydrolysis would yield the corresponding aldehydes. Sidiki and Shah,[3] however, have noted that in amidines derived



from aromatic acids -C=N-group cannot be reduced to -CH-NH- group. It would appear therefore that in the present case, the reduction is made possible on account of the presence of the N-carbethoxy group.

This new method has been applied to convert benzoic acids with various substituents like halogen, methyl, hydroxy, methoxy in ortho-, meta-, and para-positions, to the corresponding aldehydes and has been found of general applicability giving good yields at various stages.

H. P. GHADIALI.
Royal Institute of Science, M. V. SHIRSAT.
Bombay. R. C. SHAH.
October 4, 1948.

1. Shah and Ichaporia, *J. Chem. Soc.*, 1936, 431. 2. Merling, *Ber.*, 1908, **41**, 2064. 3. Shah and Sidiki (unpublished work).

## SYNTHESIS OF 4-HYDROXY-2-PHENYL 3-ACETYLQUINOLINES

IN continuation of the previous work[1,2] reported from this laboratory on the application of anilide imidochlorides to the syntheses of heterocyclic compounds, the condensation of benzanilide imidochloride with ethyl sodioacetoacetate has now been studied. The condensation of benzanilide imidochlorides with ethyl sodiomalonate[3,1] is known to give mono ethyl α-(Phenyliminobenzyl) malonates, which can be cyclised by heating to 4-hydroxy-2-phenyl-3-carbethoxyquinolines. No work however appears to have been done on the condensation of benzanilide imidochloride with ethyl sodioacetoacetate.

The condensation of benzanilide imidochloride with ethyl sodioacetoacetate has afforded an uncrystallisable intermediate condensation product namely, ethyl α-(phenyliminobenzyl)-acetoacetate, which has been subsequently cyclised by heating under reduced pressure to give the hitherto unknown 4-hydroxy-2-phenyl-3-acetylquinoline.

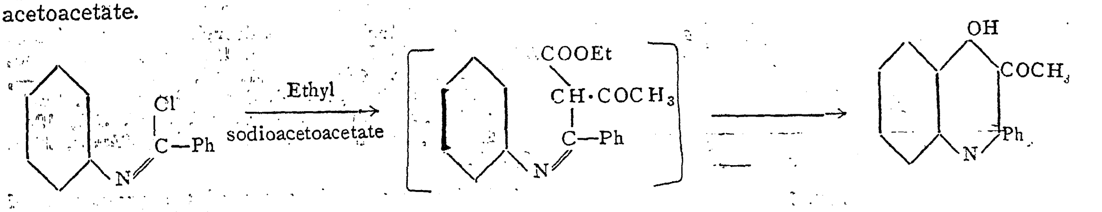
The method of synthesis is quite general and has been extended to other substituted anilide imidochlorides and the corresponding 4-hydroxy-2-aryl-3-acetylquinolines, which are otherwise inaccessible, have now been prepared.

Detailed account of the above work will shortly be published elsewhere. This work is being extended to various other β-ketonic esters and β-diketones.

The authors are grateful to the Chemical Society for a research grant for this investigation.

T. B. DESAI.
Royal Institute of Science, S. A. KULKARNI.
Bombay. R. C. SHAH.
October 4, 1948.

1. Shah and Heeramaneck, *J. Chem. Soc.*, 1936, 428. 2. Shah and Ichaporia, *ibid.*, 431. 3. Just, *Ber.*, 1885, **18**, 2025; 1886, **19**, 983, 1452 1541.



## DROUGHT RESISTANCE OF PLANTS IN RELATION TO HYSTERESIS IN SORPTION

THE problem of drought resistance of plants is of great economic importance. Attempts have been made by earlier workers to correlate drought resistance with the size of the stomata and cells of leaves[1] and certain specific properties of the protoplasm[5] of the leaves of plants. In spite of these attempts, no satisfactory correlation has yet been possible and the nature of drought resistance is obscure. It has been shown in the earlier investigations from this laboratory that the water retaining property of the soils[4] and gels of hydrous oxides[2] is mainly dependent upon the capillary structure. The present investigation was prompted by the idea that the capillary structure of the leaf tissue is probably a major factor in determining the degree of drought resistance of plants.

Balsam, Grass, Paddy, Ragi, Wheat and Oats were chosen for the study. The leaves of these plants were subjected to successive dehydration and hydration at 30° C. in a quartz fibre spring balance.[2]

The hysteresis effect is exhibited by all the systems and the hysteresis loop disappears after a certain number of hydration and dehydration operations. These investigations show that the capillaries of the leaf are made up of fairly rigid walls. The cavities with constricted necks[3] entrap water during dehydration and cause hysteresis in the earlier stages.

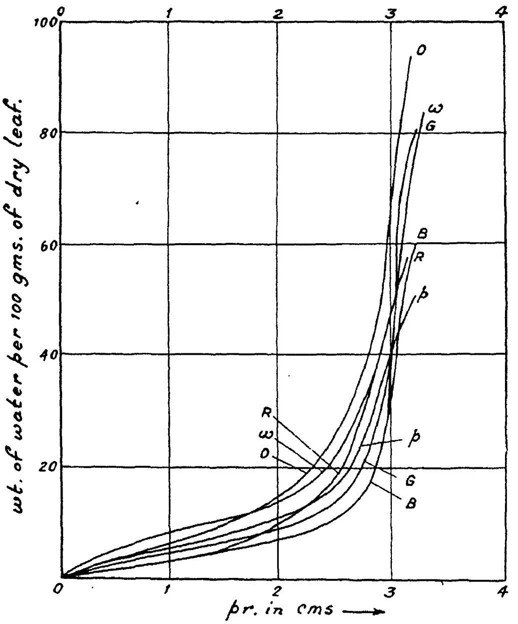



FIG. 1

Hydratmn isotherins of the leaves of Balsam (*B*), Grass (*G*), paddy (*P*), Ragi (*R*), wheat(*W*) and Oats (*o*).

The leaf can thus retain a larger amount of water during dehydration than during hydration. The entrapping effect seems to be due to the rigidity of the cavity wall. It is likely that the rigidity of the leaf tissue is a factor of importance in enabling the plants to conserve water during periods of drought.

The hydration isotherms of the leaves of the six plants are shown in Fig. 1. The relative positions of the isotherms indicate that in the relative humidity range of 0·5 to 0·95 the six plants show a gradation in the water holding-capacity. At any particular relative humidity in this range, Balsam takes the lowest and Oats the highest amount of water. The six plants can be arranged in the increasing order of drought resistance as follows: Balsam, Grass, Paddy, Ragi, Wheat and Oats—Balsam being the least and Oats the most drought resistant. In accordance with the cavity theory of Hysteresis in Sorption,[3] there is in Balsam a preponderance of wider cavities and in Oats of narrower ones.

As the leaf is subjected to successive hydration and dehydration a marked fall in the hydration capacity at the saturation pressure is noticeable during the later stages of the operation. This indicates that as a result of a number of dehydrations, the protoplasm of the leaf gets denatured and suffers an irreversible loss in hydrophilic character.

The smallest cavity neck radii in the leaves of Balsam, Grass, Paddy, Ragi, Wheat and Oats are 21·8, 18·0, 16·2, 16·2, 13·6 and 7·5Å respectively. The wider the cavity neck, the greater the ease with which water is lost by the cavity. Of the six plants the smallest neck radius in the balsam leaf which is most sensitive to drought is greater than that in Oats, the most drought resistant. The smallest neck radii of leaves of other plants are intermediate between these two values. This gradation conforms to that indicated by the hydration isotherms.

The study of hydration-dehydration hysteresis with the leaves of different plants affords a new line of approach to the highly complex problem of drought resistance in plants. It definitely indicates a correlation between the drought-resisting property of the plant and the capillary structure of its leaf.

Chemistry Department,
Central College,
Bangalore,
*November* 11, 1948.

K. SUBBA RAO.
M. BHIMASENA RAO.
B. SANJIVA RAO.

1. Maximov, "The Plant in Relation to Water."—A study of physiological basis of drought resistance. George Allan & Unwin Ltd., London, 1929, p. 297. 2. Rao, K. S., *J. Phys. Chem.*, 1941, **45**, 500–531. 3. —, *Curr. Sci.*, 1940, **9**, 68. 4. Sarada Gulvady, K. Subba Rao and B. Sanjiva Rao, *Proc. Ind. Acad. Sci.*, 1947, **25**, 229. 5. Schmidt Diwald and Socker, *Planta*, 1941, **31**, 559.

This investigation is a part of the programme of research work supported by the National Institute of Sciences of India by the award of a Senior Research Fellowship to one of the authors (K. Subba Rao, D.Sc.).

# REVIEWS

**Kunstliche New Elemente.** By Otto Hahn. (Verlag Chemic, GMBM Weinheim/Berstrasse, Berlin), 1948. Pp. 50. Price D. M. 2·50.

The discovery of the fission of uranium and the possibility of chain reaction led Fermi to the development of a device now known as the "Uranium Pile" in which the chain reaction could be controlled and sustained. Such a pile serves as an extremely powerful source of neutrons with the help of which it has now become possible to prepare weighable quantities of any element (stable or radioactive) by artificial transformation. This monograph contains a brief account of eight new elements which are of great interest from the chemical point of view. It has been written by one who is an authority on nuclear chemistry.

The book is roughly divided into five sections. In the introductory section, the author traces the history of the development of nuclear physics. In the succeeding section, starting with the early experiments on the neutron bombardment of the heavy elements, especially uranium and thorium, carried out by Fermi on the one hand and by Hahn, Meitner and Strassmann, on the other, the author describes the crucial investigations of Hahn and Strassmann and of Curie and Savitch which finally culminated in the discovery of the fission of the uranium nucleus into roughly two equal parts. The discovery of the emission of secondary neutrons following uranium fission and the possibility of a chain reaction are discussed in the third section. The essential details of the construction and working of the "Uranium pile" are also given in the same section. The fourth section is on artificially prepared new elements. The various methods of preparation in small as well as in large quantities and the properties of eight new elements are given.

They are:—
(1) element 43, Technecium (Tc), (2) element 61, (3) element 85, Ekaiodine or Astatine (At), (4) element 87, Fracium (Fr), (5) element 93, Neptunium (Np), (6) element 94, Plutonium (Pu), (7) element 95, Americium (Mm) and (8) element 96, Curium. (Cm).

In the concluding section, the author has given some pertinent remarks on the position which the transuranic elements occupy in the periodic system.

The subject-matter of the book is presented in a simple and easily readable form. The book though written in German will be very handy for workers in the field of nuclear physics.

R. S. K.

---

**One Story of Radar.** By A. P. Rowe. (Cambridge University Press, Cambridge), 1948. Pp. xii + 208. 8*sh.* 6*d.* net.

The years since the close of World War II have been remarkable for the number of popular and semi-popular books on atomic bombs and nuclear energy. This over-emphasis on one aspect of research has been responsible, more than any other single factor, for the impression steadily gaining ground in the public mind that scientific endeavour, irrespective of the motive urging the investigators, spells speedier march towards the destruction of modern civilization, if not of mankind. 'One Story of Radar' tends to correct this impression by presenting the picture in its proper perspective. It is worthwhile noting here that the author is of opinion that "few in a position to judge would hesitate to name the cavity magnetron as having had a more decisive effect on the outcome of the war than any other single scientific device evolved during the war. It was of far more importance than the atomic bomb, which had no effect at all on the outcome of the German war and contributed rather to the shortening of the Japanese war than to its result," and that "Had there been a scientist in the Victory Parade, he might well have carried on his banner the inscription: "My profession saved a million lives."

The book traces the history during the fateful decade following 1935, of the fortunes and vicissitudes of the Telecommunications Research Establishment (T.R.E.) in its wanderings from the lovely "Island"—actually an isthmus— of Orfordness and its neighbour the Bawdsey Manor on the east coast of England through Worth Matravers and Swanage in the South to Malvern College in central England, with a depressing but brief halt at northern Dundee thrown in between. The narrator is its own Chief Superintendent. The progress achieved by T.R.E. within this period can be gauged to some extent by observing that the Establishment which started by demonstrating a radiolocation gadget "that could measure the height of an aircraft flying at 7,000 ft. with an error of little more than 1,000 ft." was responsible eight years later for placing at the service of the Bomber Command a device known as the Oboe whose operators "sitting in comfort in England, could follow with great accuracy the track of an aircraft as it flew over a target 250 miles away, could calculate its speed" and could signal it when to release the bomb load on the target with an error not exceeding a few hundred feet. The thousand bomber raids over the Ruhr area in 1942-43 could not have been successfully organised without the aid of an appliance such as the Oboe. This progress followed closely on the heels of the development of Oliphant's klystron and the magnetron, the two devices that pushed the shortest wavelengths at which electro-magnetic waves could be usefully handled and generated from a couple of meters in 1935 to a few centimeters by 1942. The measures and counter-measures adopted in the Bay of Biscay submarine warfare indicate that that struggle might appropriately be termed the battle of wave lengths in which the contestants were the scientists of the opposing sides.

The author makes no attempt whatever to weary the reader by dwelling on the technical details pertaining to radar appliances, as there is an abundance of literature on such

topics available elsewhere to the inquirer so interested....On the other hand, hegives an eminently readable account of the circumstances and the military need that gave birth to the idea of a new radar appliance, of the pursuit of that idea and its subsequent culmination in the form of a laboratory instrument, of the conference table at which Civilian Scientists and Military Chiefs had to decide whether the baby instrument should die without a progeny or be permitted to evolve into a prolific race of factory built models and in the latter event, of the modifications to be incorporated so as to meet the requirements not only of large-scale production methods, but also of a modicum of secrecy and finally of its use in military operations and the part it played in shaping the future course of War. The success of such a scheme depended on the speedy and whole-hearted mingling of the variegated patterns of mind and habit of the men concerned. It is therefore not surprising that the author does not tire of repeating the importance of the creation of team-spirit among the workers of T.R.E. or of the unceasing effort that T.R.E. made to interpret the scientist to the user and the user to the scientist. As he truly observes, "the war might well have taken a different course and would certainly have cost us more dearly if the Service user and the radar scientist had got together in Germany as they did in this country."

It was inevitable that these men should resort to some method of relieving the intense emotional strain under which they lived and worked. That one of these methods was the christening of their creations by odd yet piquant names reveals a human and lovable side to their character. To give a few instances, the Plan Position Indicator that enabled the pilot to home on to a target was named $H_2S$—abbreviation for Home, Sweet Home, we are told—(not for the nasty smelling gas?); the components of the Oboe, whose tunes wafted the aircraft to its destined target, were named the Cat and the Mouse; the Eureka and the Rebecca were the names selected respectively for the Radio Beacon established by the landed paratroops and for the receiver installed on the aircraft carrying further reinforcements; and not to be beaten by the mere scientist, the Air Force gave the Research men who pestered it incessantly with their demands to be consulted and heard, the pet name 'Boffins', while the informal conference at which the Military and Scientific officers wrangled vociferously was named the Sunday Soviet.

The reviewer has one grievance against the author. In the chapter on "Some Memories and Features of T.R.E.," he gives an account, as instructive as it is delightful, of the elaborate precautions they would take to ensure that their Visitors' Days should be impressive. Before being taken round the establishment, the guests would be shown coloured diagrams and training devices displayed in the Office-Room and the Hall of Magic. A selection of these illustrations in the form of a few more plates supplementing the existing seven plates would have materially added to the attractiveness of the book. A perusal of the book would convince any reader that Mr. A. P. Rowe's efforts in this direction could not but have been distinctive. A printer's error, minor in itself, but likely to confuse some readers intrudes on p. 204 where 'inadequate' is printed where as obviously 'adequate' was meant.

This is a book that has a message of deep import for the scientist and the general public as also for the Civilian and Military Administrative Chiefs. It is to be hoped, in particular, that the Telecommunications Research Laboratory that is to be shortly opened at Jubbulpore will not fail to be benefited by the experiences of the British T.R.E.

R. L. N.

---

**Velocity Modulated Thermionic Tubes.** By A. H. W. Beck. (Published by the Cambridge University Press), 1948. Pp. x+180. Price 15s. net.

The timely publication of this volume which presents a general introduction and principle of operation of V.M. tubes adds greatly to the fund of scientific knowledge and indicates a great scope of research in this newly developed line. The treatise aims at building up theories from simple postulates and attempts to present a realistic picture of the subject. Suggestions for further scope of work deserve special attention.

Starting with historical introduction and status of V.M. tube art before World War II, the first two chapters devote to the theory of cavity resonators from the standpoint of vibration modes of oscillating mechanical systems, theory of V.M. process for small signal, etc. In Chapter three, calculation procedure for output efficiency of a klystron oscillator as a function of the ratio of starting current to running current has been outlined. Chapter six is an extension of chapter three and presents a large signal theory sufficiently adequate for engineering purposes. The problem of focussing electrons through different types of tunnels is an important feature in klystron design. This is discussed in Chapter four. The fact that coupling of extra resonators to the same beam increases gain much more than that of a simple V.M. power amplifier, induces chapter five to emphasise that the development of multiresonator system will be of great help to the stable frequency microwave communication system. Chapter seven deals with the theoretical aspects of reflex klystron. It is pointed out that though the large dissipation in resonator surface and difficulty of arranging a smooth control of reflector characteristics present a serious handicap for the manufacture of high power reflex klystron, the possibility of obtaining higher frequencies creates a good promise for this type in receiver design. Discussing about the less well known embodiments of V.M. ideas Chapter eight suggests a great scope for research in microwave valve mixers. The interesting discussion presented in Chapter nine about osillation hysteresis, modulation problems etc., indicates a clue for both theoretical and experimental development. The last chapter presents in a qualitative way the main conside-

ration that should be taken into account when designing a V.M. tube. The example worked out in Appendix 1 on the design of a high power C.W. klystron is highly instructive and helpful. Appendix 2 gives a brief analysis of travelling wave tube which promises to play a great role, especially, where large gain associated with wide band width is desired.

The volume under review like other Modern Radio Technique series publication, will serve as a very useful addition to the existing knowledge of microwave technique. This book is highly recommended to those engaged in microwave research on both fundamental as well as design aspects.

S. K. C.

**The Diary and Sundry Observations of Thomas Alva Edison.** Edited By Dagobert D. Runes. (Philosophical Library, New York), 1948, Pp. 247. Price $ 4·75.

The selections from the notes, statements and observations of Thomas Alva Edison, which comprise this handy volume of 240 pages, bring out the personality and greatness of "one of the world's greatest benefactors", who initiated the electro-industrial era of our time. There is perhaps no one who has passed through a school that has not read or heard of Edison. While not a few of the thousand inventions which bear the impress of his skill and ingenuity are widely known and their benefits widely enjoyed, the knowledge relating to the man himself, his life and work, is not widespread. The Editor of the collection must be congratulated for bringing together representative selections from his mumerous writings, which give a glimpse of his personality, and for making them available to the general reader.

In the book under review, the reader is taken through "a fascinating trip into the unknown as it were," and provided an opportunity to witness the working of the ever alert, eminently practical mind of an experimenter deliberately searching out new paths and new ways into the mysteries of nature. The inventions of Edison are not the results of brain waves; they were products of intense thinking and systematic experimentation. He was entirely self-made and self-educated. He did not hold any sinecure jobs with fat emoluments. He was drawn into experimenting and inventing inevitably as it were by the sort of discipline which he chose to give himself. He had no illusions about the lot of the inventor.

This is what he says about the inventor:—

"The inventor tries to meet the demand of a crazy civilization. Society is never prepared to receive any invention. Every new thing is resisted, and it takes years for the inventor to get people to listen to him and years more before it can be introduced, and when it is introduced our beautiful laws and court procedure are used by predatory commercialism to ruin the inventor. They don't leave him even enough to start a new invention." This was the lot he chose for himself, and his whole life is an object lesson in plain living and high thinking.

The Diary, covering 59 pages, gives a glimpse of Edison's daily life. His reading was voracious. He would read fiction and immediately switch on to the study of a journal of higher mathematics. His prescription for steadying nerves was the study of *Encyclopœdia Brittanica*. He read New York World for his mental breakfast and glanced through accounts of murders "to keep him in touch with human affairs." He read Goethe to lull him to sleep. When he entered a book shop he found a thousand books that he wished to read. He did not read just a few books but read whole libraries. "Almost any book will supply entertainment or instruction," he says. He was deaf but he was not only not overpowered by his deafness, but he deliberately planned to develop the other gifts with which he was endowed. The deafness, for instance, did not prevent him from hearing the clicking of a telegraph instrument when he was near it, as an operator always must be. In fact, his deafness proved to be an advantage; it made him immune to the outside distracting noises. He was cut off from "that particular kind of social intercourse which is small talk", and thereby found freedom to think out his problems. "The things that I have needed to hear, I have always heard," he says and continues "Most of the nerve strain of our modern life, I found, comes to us through our ears". To him Broadway was a peaceful thoroughfare. His inventions made it possible to build a world "in which the person who is deaf will have a definite advantage". Here is a personality, who not depressed by the loss of hearing, turns it into a positive asset. It illustrates in a most eloquent manner, Edison's outlook on life, and no wonder, his life was full of achievement.

There are in Edison's writings, many tracts of wisdom, many correctives for man's failings and weaknesses, and many suggestions for educationists and social workers. His optimism in the future prosperity and greatness of America is robust. Educational developments, he believes, will help in raising a better and progressive generation of citizens and parents, leaders, scientists and business managers. Whatever he writes, whether it relates to ethics or education, music or philosophy, is direct, clear and precise, revealing a master expounding his thesis in a simple and lucid language. This is a book which every one ought to read. There is much in it that is original thought-provoking and instructive. There are few books to compare with it which can be read with both pleasure and profit.

B. N. Sastri.

Animals Alive. By Austin H. Clark. (D. Van Nostrand Co. Inc., New York, Macmillan & Co. Ltd., London), 1948. Pp. viii+472. Price $4·00. Sterling Price 22*s.* net.

Considering that Zoology is a serious subject, the book under review which deals with the Animal Kingdom as a whole in relation to man and his physical universe is a welcome addition to our general or natural history Libraries,

The test of popularity of any serious publication does not lie merely in the number of copies sold or in the number of editions it has gone through or in its moderate price, but in the avidity and zest with which an average reader can return to it again and again. Judged by this test, "Animals Alive" ought to prove a good seller and have an appeal to the lay general reader as well as to the specialist. Zoology, as presented in text-books, is not usually a subject that can have an universal appeal. Not all serious students of Zoology would care to read a text-book more than once were it not for the fact that there is usually an examination to pass. While "Animals Alive" reads like a novel, it is in fact a general text-book of Zoology shorn of its annoying and difficult technical terms in Latin and the irksome and uninteresting details of structure and function.

The purpose of this publication, as stated by the author himself in the preface, is to answer in an intelligible way questions which may arise in the mind of the general reader without special technical knowledge in reference to the relationship of the animal world to man and of the various types of animals to one another and to the plants and their physical environment on land and water, and the relationship of the living world to our universe as a whole.

The book is divided into four parts. The first part deals with man and the animal world, the second with land animals, the third with fresh-water animals, and the fourth with life in the sea. Each part is divided into a number of chapters the longest of which does not exceed 20 pages and the shortest does not fall below 4 pages, the average length of a chapter for the whole book being eleven pages. Brevity of chapters is an advantage to the slow and deliberate reader who desires to enjoy as he unconsciously assimilates. It stimulates without tiring the reader.

Within the space available for a review of this kind it will not be possible to touch upon anything but a fraction of all the interesting details of animal life with which the book is packed. The association of man with the animal world has a long historic background, and "a true understanding of the latter is not possible without, first of all, a somewhat detailed appreciation of man's most intimate contacts with it, especially with those numerous and varied types which have been brought under domestication and those more numerous and more varied types against the depredations and attacks of which he must be constantly on guard." The number of domesticated animsls which have descended from ancestors of Asiatic origin seems to be unexpectedly large. The dog, the horse, the sheep and goats, the pig, the humped cattle and the yak, the camel and the elephant, the barn-yard fowl and geese, the pigeon and the peacock, all appear to have such origin.

The chapters dealing with animals of all classes which are of some importance to man or are obnoxious to him or his domesticated animals are by far the most interesting and make reference to the honey bee, the silk worm, the lac insect which derives its name from lakh with its Sanskrit derivative "laksha" from the fact that they are abundant wherever found, the fur-bearing land animals, and the sea animals which provide him with food and other economic products. These chapters are literally packed with rare and interesting observations, a few of which may be mentioned here: Mosquitoes occur in the Arctic regions in millions, while some feed on gorged bed-bugs and suck blood from the backs of turtles. The mosquito-fly or human bot-fly is known to attach its eggs to a female mosquito to enable the little maggots to enter into the puncture made in man or mammals by the mosquito where it lives until fully grown and ready to pupate in moist soil. Very few would fail to be surprised to know that there are insect predators which chew metal or minerals in the same way as our sophisticated moderns chew gum, omnivorous saw-toothed grain beetles which do not scorn to live and breed in red pepper or chillies, bore into cigars and cigarettes, and eat snuff.

Chapters 7 & 8 of Part I contain some of the most interesting and weird facts about the food and feeding habits of man and animals in various parts of the world. It would be shocking to the most refined and confirmed non-vegetarian in India, peopled by innumerable primitive tribes with a wide range of animal menu to their credit, to learn that the skin of certain whales, the stomach contents of the Greenland reindeer, the dried grasshoppers, the luscious queens of Indian termites, the pickled beetle grubs of Mexico, the pupæ of silk-worm moths and even the baked centipedes of Polynesia are considered delicacies by some people in some parts of the world.

Apart from finned, hoofed and winged animals of all kinds on land and water, man has included in his dietary a great variety of the lesser known vertebrates and invertebrates. Among the vertebrates may be mentioned the tapirs, ant-eaters and sloths, porcupines and armadillos, pumas and monkeys, bats, the large, reptiles like the iguanas, crocodiles, sea and land-snakes, and the salamander. Even the lancelets and sea-squirts which are considered distant relations of vertebrates are fished for food in China Seas and the Mediterranean Seas respectively. Among the inverteates are the squids, sea-urchins, bristle and other sea-worms, barnacles, jelly-fishes, and sea-anemones. We have the testimony of the author himself who has had the courage to verify that the claims as to taste and nutritive value made for some, at any rate, of the formidable array of food items mentioned in the book, are not exaggerated. The author has also marshalled facts to prove the truth of the saying "one man's food is another man's poison", and to show that there can be no death from starvation in many parts of the world if only the human palate can be educated to relish the wide range of dietary provided by nature.

An appendix is provided at the end of the fourth part dealing with the classification of animals as under: 1. bilateral symmetry, 2. animals with mixed symmetry (bilaterally modified by more or less evident radial symmetry, often most obvious in the nerves), 3. animals with radial symmetry, 4. unorganisedr animals, 5. singlecelled animals There is an unusually good index covering 37 pages

but unfortumately this does not include the alliterative *onomatopœia* on p. 48 which no standard English dictionary explains

The book is illustrated with clear black and white drawings of examples of most groups of animals dealt with in the book. One wishes that the feeding of the African caterpillar described on p. 131, and the S. American Matamata referred to on p. 218 had been figured.

The reference to the food-collecting mechanism of the sponges and to the boring habits of some sponges does not seem to accord with the classification of the Sponges as an unorganised group and with the more or less accepted view that Sponges constitute a separate sub-kingdom (Parazoa) equal in rank to that of the Protozoa or the Metazoa.

The freshwater jelly fish, *Limnocnida* common to Africa, India and China, to which no reference is made, seems to be better known in S. Eastern Asia than *Microhydra*. What has been stated about the breeding of the Indian elephant is generally true, but it may interest readers to know that one or two cases of domesticated Indian elephants breeding in the Andaman islands are recorded.

The excellence of the paper, printing and get-up of the book is somewhat marred by a number of printer's errors on thirteen pages (Pp. 3, 15, 69, 78, 128, 316, 362, 379, 384, 400, 429, 432, 433). It is hoped that in reprinting this excellent and readable book on Zoology the publishers will rectify the errors and endeavour to maintain the reputation of the publishing trade in U.S.A.

Notwithstanding the few errors of commission and omission no general or specialist library in India can do without this book on its shelves.

H. S. R.

---

**Oncidium.** By P. R. Awati and K. R. Karandikar (Zoological Memoirs' The University of Bombay), 1948. Pp. 53. Price Rs. 3.

From Lucknow, a series of memoirs on Indian animal types was being published with the object of familiarising the zoology students of Indian Universities with Indian examples. The Lucknow editors have not yet exhausted the list of specimens they drew up to describe when the University of Bombay has projected a memoir on *Oncidium* with the same object of putting before the students of zoology, particularly that of Bombay University, descriptions of Indian types. While we welcome correct and comprehensive accounts of as many Indian examples as possible, we only hope that there will be no duplications.

The memoir, under review, deals with the anatomy, bionomics and embryology of the marine pulmonate slug, *Oncidium*. The systematics of the example are described in Section A and unfortunately nowhere do we learn the name of the founder of the genus or of the species of *Oncidium*.

Section B deals with external morphology. It would have been excellent if the publishers had reproduced Figures 1 and 2 as plates or even better, if the authors had given a coloured plate or plates, indicating suitably the size of the animal drawn.

In describing the histology of the radular support, the authors refer to a celluar body of polygonal cells with nuclei. A discussion of the nature of this tissue would have been most welcome.

In Figs. 7 and 21' the opening of the hepatic ducts are described as 'Liver openings' and 'opening of the Liver-gland' respectively. The authors themselves refer to three hepatic ducts on page 23, and instead of leaving the student in doubt, they could have clearly indicated in the figures, the openings as those of hepatic ducts.

The 'cell membranes' are noted to be not discernible in the pulmonary tissue. If the cell outlines are not seen even under high power of the microscope, it is not discussed if the syncytial tissue is helpful in gaseous exchange. The student will be anxious to know how the animal inhales air and the mechanics of respiration which is not described in any text-book may, therefore, have been given in detail.

The ventricle is described as 'thickly set muscular organ' and also that 'Its inside is filled with muscle-bands.....' The description would have been better understood if these bands were incorporated in Fig. 35.

In a number of places in the text, a reference is made to 'body cavity' and the student will be able to comprehend better, if a connected account of the hæmocœl and hæmocœlic canals or sinuses and the cœlom was given, like all other systems, separately.

The early cell-history during development is described but the nature of the yolk content and of cleavage are not included. At any rate, figure 55 shows four unequal micromeres derived from four equal blastomeres.

The get-up of the book leaves much to be desired. References are frequently misquoted, (page 4, 40 Watson, 1926; page 6, 14 Plate, 1892) or completely omitted (Berge, 1882). The reference list on page 53 could have been arranged with greater care. A few of the devils amongst others, are given below which could have been easily avoided: p. 4, mediun for median; p. 14, cartilagenous for cartilaginous; p. 26, diaphragum for diaphragm; p. 53, Harward for Harvard, and Joyeux-Laffuie is written in at least three different ways (p. 12, 50).

The usefulness of the memoir could have been considerably heightened if these shortcomings had been envisaged particularly as it is meant for the students.

L. S. R.

---

**Mysore Geological Department Records, XLIV, (1948).**

The Director Mr. B. Ramarao summarises in the first article, the activities of the Department for the year 1945 wherein statistics of the production of minerals both by the department and private agencies with their values are recorded. The Mysore Geological Department have been pioneers in the country in taking up utilisation and prospeting work as supplement to their survey work and their activities as recorded by the Director, serve as an example to the other Geological Surveys in India and States.

In the second Chapter Mr. B. Ramarao contributes a paper on gold investigations in Mysore and gives an excellent summary of the gold mining activities, and more particularly of the recent and current attempts of the Geological Department to reopen some of the ancient mines. In a diagrammatic representation showing the percentages of gold production of each of the principal producing countries in the year 1940 it is shown that Africa produced about 41% of gold. Europe about 12%, Asia about 9% (of which India's share is 0·7%), Australia about 6%, Central America about 5% and North America about 27%. Almost all the gold produced in India goes to the credit of Mysore State. An excellent case has been made out in this paper for extending prospecting operations to other promising areas not only in the State but also in other parts of India.

Mr. Lakshmana Rao's paper on the road metals and lesser minerals details suitable quarry sites for building material and road material and on the occurrence of some economic minerals like lime kunkur, clays, corundum, quartz and felspar.

Mr. M. B. Ramachandra Rao's contribution on 'Geophysical Prospecting for Graphite' has a negative value in that it finds that the results of geophysical prospecting give no indications of workable deposits. Mysore Geological Survey Department also leads the rest of India in having introduced geophysical methods for engineering and prospecting problems and Mr. Ramachandra Rao has already a fine rocord of work to his credit in Mysore and elsewhere in this direction.

The last paper is a 'Note on Bowenite and Talc picrolite from 'Holinarsapur area' by Mr. Tirumalachar.

This record, suitably illustrated by diagrams, maps, and plates keeps up the traditions of the publications of the Mysore Geological Survey Department.

C. MAHADEVAN.

**Eradication of Water-Hyacinth and Production of Compost Manure.** By Megh Nath Basak. (Brochure issued by the Directorate of Agriculture, Government of West Bengal).

In this brochure, Mr. Basak has drawn attention to the urgent necessity of securing complete eradication of water-hyacinth from the Provinces of Bengal and Assam. Not only has the extensive occurrence of water-hyacinth rendered navigation in many parts of the Provinces hazardous, and affected agriculture, a conservative estimate placing the annual loss of deep-water paddy due to depradation by the weed at eleven crores of rupees, but also has raised acute problems of water pollution and public health.

Various methods suggested, in the past, for eradiction of the pest have, in practice, not been successful owing to the heavy financial burden they involve. The manufacture of different substances, such as starch, fibre, paper-pulp, etc., from water-hyacinth has also not proved economically feasible.

During 1946, composting of hyacinth, by improvising Dr. Acharya's 'Bangalore' Method to suit local conditions, was carried out at selected centres in Bengal under the supervision of Mr. Basak. In the light of experience gained then, he has advocated production of compost from hyacinth all over the Provinces as a means of eradicating the pest, at the same time securing a valuable manure. Extensive data have been cited to show that the sale of the composts produced would more than compensate the cost of the production.

While further information regarding the extent by which incidence of the pest has been brought down in the areas where composting was carried out in 1946, and also regarding the response of crops to hyacinth-composts, would have been particularly useful, the publication of the pamphlet is to be welcomed as showing a way of tackling the problem. Success in this direction lies in a concentrated effort by the Governments and Public Organisations, no less than by private agriculturists.

C. R. H.

## INDIAN STANDARDS INSTITUTION CHEMICAL DIVISION

MORE than one hundred and ten chemical manufactures have already been referred for purposes of standardisation to the Chemical Division Council of ISI., which was inaugurated today in New Delhi by the Hon'ble Dr. Syama Prasad Mookherjee, Minister for Industry and Supply.

The Council on which all the units of chemical industry in India are represented has elected Dr. H. L. Roy of the College of Engineering and Technology, Jadavpur (Bengal) as Chairman.

Pointing out the fact that Indian industry had offered maximum co-operation with the Indian Standards Institution in all its aspects of work, the Hon'ble Dr. Mookherjee observed that while the Government realised their ultimated responsibility in respect of legislation for enforcing standards, industry's helpful attitude in this matter proved that, meanwhile standards could be fixed and enforced by mutual co-operation between the Government and industry. The establishment of the Chemical Division could help to raise the standard of production, he said, not only in the chemical industries themselves but in all those other industries which depended on the utilisation of chemicals.

It was pointed out at the meeting of the Council that besides the 110 odd subjects proposed by members of ISI for the attention of the Chemical Division, the latter was also interested in the work of the International Standards Organisation relating to a number of items such as petroleum products, varnishes, paints, etc., rubber,—plastics and general definitions relating to Chemical and Physical Test Results. The Chemical Division will take over the organisation of the secretariat for the International Standards Organisation's Committee for Shellac.

# SCIENCE NOTES AND NEWS

## Constitution of Phenyl Thiourea

Rameshwar Dayal Gupta Chemical Laboratories, Birla College, Pilani (Jaipur), has asked us to announce that:—

"Work is being carried out in his laboratory for the elucidation of the constitution of Phenyl-thiourea by electrometric means. The titration curves have indicated two well-defined inflexion points establishing its acidic nature and the existence of two dissociation constants."

## Freezing the Earth to Mine Coal

According to British Information Services (issued by the office of the U. K. High Commissioner in India), British Mining Engineers are freezing a portion of the ground near Calverton, in Nottinghamshire, in order to sink a new pit for mining coal. The freezing of the ground to a depth of 412 feet is necessary to seal off the underground water in the porous sandstone through which the colliery shaft has to be sunk. If this were not done, there would be a flooding of the ground water into the shaft at the rate of 1,000 gallons per minute.

The freezing is said to be accomplished by driving 25 pipes in a circle through the sandstone and circulating brine cooled to 37° below freezing point. A suitable refrigeration plant has been installed. It is expected that in two months, a long cylinder of ice will have been formed and the actual sinking of the shaft will then be undertaken. The proposed output of coal in this virgin field is estimated at 1 million tons a year.

M. B. R. Rao.

## Allocation of Radio-Active Isotopes

A committee to decide priorities in allocating radio-active and stable (non-radio-active) isotopes has now been set up in Britain under the chairmanship of Sir John D. Cockroft, Director of the Ministry of Supply's Atomic Energy Research Establishment at Harwell.

"Gleep", the low energy pile at Harwell, is already providing limited quantities of radio-active isotopes and facilities for experimental workers and arrangements have been made to buy U. S. and Canadian radio-active isotopes to supplement these supplies until the large pile at Harwell is operating at full power probably early next year.

Persons requiring isotopes must have their requests sponsored by the Medical Research Council, the Agricultural Research Council or the Department of Scientific and Industrial Research whose representatives are members of the newly- appointed Committee.

At present the radio-active isotopes from Harwell are being distributed directly to the customer. Where production involves chemical extraction or where processing or synthetic work is necessary, the work will ultimately be carried out at the Ministry of Supply Radio-chemical Centre at Amersham.

Radio-active elements are daily coming into more extensive use for industrial, agricultural, medical and general scientific research. One of the most useful of these is phosphorus which after being "cooked" in an atomic pile becomes radio-active and can be used to trace disease in men, animals and plants and to detect flaws in steel among other purposes.

## Committee to Review Patent Laws

The Government of India have set up n Enquiry Committe to review the patent laws in India, with Bakshi Sir Tek Chand, Retired High Court Judge and Member, Constituent Assembly of India, as Chairman.

Dewan Bahadur K. Rama Pai, Retired Controller of Patents and Designs, will act as Member-Secretary to the Committee. The terms of reference to the Committee are as follows:—

1. To survey and report on the working of the Patent System in India.

2. To examine the existing Patent legislation in India and to make recommendations for improving it, particularly with reference to the provisions concerned with the prevention of abuse of patent rights.

3. To consider whether any special restrictions should be imposed on patents regarding food and medicine.

4. To suggest steps for ensuring effective publicity to the patent system and to patent literature, particularly as regards patents obtained by Indian inventors.

5. To consider the necessity and feasibility of setting up a National Patents Trust.

6. To consider the desirability or otherwise of regulating the profession of patent agents.

7. To examine the working of the Patent Office and the services rendered by it to the public and make suitable recommendations for improvements. And

8. To report generally on any improvement that the Committee thinks fit to recommend for enabling the Indian Patent System to be more conducive to national interest, by encouraging invention and the commercial development and use of inventions.

It is expected that the Committee will start its work at an early date with New Delhi as its Headquarters. It will visit such places as it may consider necessary and will take evidence on questions arising from the terms of reference.

Persons who desire to be called as witnesses should apply in writing to the Secretary of the Committee, C/o Ministry of Industry and Supply, Government of India, New Delhi, giving their full names and addresses, together with a brief memorandum of the points in regard to which they desire to give evidence.

## Professor Marcus L. Oliphant

The world famous Australian-born atomic scientist has been appointed Director of the Research School of Physical Sciences at the Australian National University at Canberra, according to an announcement by the Vice-Chancellor of the University, Prof. Copland.

Prof. Oliphant is at present Professor of Physics and Director of the Department of Physics at the University of Birmingham. It may be several years before he can take up the Australian appointment, but in the meantime he will advise the Interim Council of the university on the organization of the new physical science laboratory and its equipment.

A Birmingham colleague of Prof. Oliphant has been appointed Chief Technical Officer. He will come to Australia next year.

## FAO Office for Asia and the Far East

The Food and Agriculture Organization of the United Nations announced today that an FAO regional office for Asia and the Far East will be established in Bangkok in the near future and will be in full operation early in 1949.

The FAO Regional Representative for Asia and the Far East will be W. H. Cummings, a United States citizen born in Burma. Mr. Cummings, who is now in Asia, will go to Bangkok soon to make arrangements for opening his office there and for recruiting clerical and administrative officers. These, in so far as possible, will be drawn from within the region. Such technical officers as are required will be assigned from FAO headquarters.

The office at Bangkok, FAO said, will maintain close liaison with headquarters of the United Nations Economic Commission for Asia and the Far East at Shanghai and with other regional offices which may be set up by United Nations organizations.

With the establishment of the Bangkok office, FAO will have three regional offices in operation—at Rome, serving Europe; at Cairo, serving the Near East; and at Bangkok. Plans for developing FAO regional representation for Latin America are already well advanced.

## Zoological Survey of India

In April 1942 the Zoological Survey of India was temporarily transferred to Benares from its original headquarters at the Indian Museum, Calcutta, as a war measure. As a result of the decision of the Government of India to retransfer this department to Calcutta this year, a large part of the zoological collections has already been shifted to Calcutta. It is expected that the transfer will be completed by the beginning of 1949.

From January 1, 1949, the address of Zoological Survey of India will be: "Janakusum House," 34, Chittaranjan Avenue, Calcutta.

## Dr. B. R. Seth

Dr. B. R. Seth of the University of Delhi has been invited as Visiting Professor of Applied Mathematics for the year 1949 in the University of Iowa, U.S.A., and will be in residence from January, 49 to December 49, at the Iowa State College, Ames, U.S.A.

Dr. Seth also attended the Seventh International Congress of Pure and Applied Mechanics held in London during September 1948 as an Indian delegate.

## Botanical Society of Bengal

The Honorary Secretary, Botanical Society of Bengal has asked us to announce the following:—

"A half-yearly list of Botanical papers printed in India, Pakistan. Burma, Ceylon, Siam, Malaya and Indonesia will be published by the Botanical Society of Bengal in the Society's Bulletin issued in April and October every year. Authors are requested to kindly send their reprints to the Honorary Secretary, Botanical Society of Bengal, 35, Ballygunj Circular Road, Calcutta 19, to facilitate this compilation work."

## I. C. S. U.

We are glad to announce that the following 10 Scientific Unions have federated themselves into the International Council of Scientific Unions.

*I.A.U.*—International Astronomical Union.—General Secretary: Prof. J. H. Oort, Sterrewacth, Leiden, Netherlands.

*I.U.B.S.*—International Union of Biological Sciences.—General Secretary: Prof. P. Vayssiere, Museum National d'Histoire Naturelle 57, rue Cuvier, Paris V.

*I.U.C.*—International Union of Chemistry.—General Secretary: Prof. R. Delaby, Ecole de Pharmacie, 4, Avenue de l'Observatoire, Paris VI.

*I.U.Cr.*—International Union of Crystallography—General Secretary: Dr. R. C. Evans, Crystallographic Laboratory Free School Lane, University of Cambridge, England.

*U.G.G.I.*—Union Geodesique et Geophysique Internationale—General Secretary: Dr. J. M. Stagg, Kew Observatory, Richmond Surrey, England.

*U.G.I.*—Union Geographique Internationale—General Secretary: Mlle M. A. Lefevre, Institut Geographique Paul Michotte 2, rue des Doyens, Louvain, Belgium.

*U.I.H.S.*—Union Internationale d'Histoire des Sciences—General Secretary: Prof. P. Sergescu, 7, rue Daubenton, Paris V.

*I.U.P.A.M.*—International Union of Pure and Applied Mechanics—General Secretary: Prof. J. M. Burgers, van Houtenstraat 1, Delft, Netherlands.

*I.U.P.A.P.*—International Union of Pure and Applied Physics, General Secretary: Prof. P. Fleury, Institut d'Optique, 3, Bld. Pasteur, Paris XV.

*U.R.S.I.*—Union Radio-Scientificque Internationale—General Secretary: Col. A. Dorsimont, 42, rue des Minimes, Bruxelles.

Editor: M. Sreenivasaya, B.A., F.I.I.Sc., F.A.Sc.
1253-48 Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore

" Current Science " – Raman's Sixtieth Birthday Number, Dec. 1948

SIR C. V. RAMAN, Kt., F.R.S., NOBEL LAUREATE

Current Science

Vol. XVII] DECEMBER 1948 [No. 12



# SIR C. V. RAMAN AS PHYSICIST AND TEACHER*

A BRIEF review of the investigations in the field of crystal physics, carried out by Sir C. V. Raman and his pupils appears in this issue as a supplement.† We only wish to indicate here a few characteristic features of the scientific work of Sir C. V. Raman, his approach to research and his relationships with his pupils.

The most obvious characteristic is his great passion for physics coupled with an intense enthusiasm and volcanic energy. Even the most casual observer cannot fail to miss the fire in his sparkling eyes which seem to radiate this energy, and to be animated by the dynamic force of an active brain. He lives for his work as few men do, and by his exceptional tenacity of purpose and hard work in the pursuit of research he has set a shining example to others.

He has a deep insight into physical processes, and an intuitive sense of physical reality. He has often shown the ability to illuminate a whole subject with a few crucial ideas. His highest work shows the inevitable simplicity of all great work, and has been achieved by spontaneously taking the significant step at the right moment. He possesses in a remarkable degree the gift of seizing the vital point from apparently trivial observations. This genius for picking out the true significance of what to others would be an unimportant detail, and transforming it into a clue for the understanding of fundamental problems is brought out strikingly in his work leading to the discovery of the Raman effect itself.

Raman is a born experimental physicist, and has been guided by the conviction that

* From the Sir C. V. Raman Sixtieth Birthday Commemoration Volume *Proc. Ind. Acad. Sci.*, Nov. 1948, Bangalore.

† *Vide* Supplement.

real progress in physics can be achieved only by the application of considerations based on experience and reason to experimental observations of properly chosen phenomena. He has advanced directly and successfully along this straight path without often branching into mathematical physics. Yet whenever occasion arose he has shown that he possessed the mathematical equipment essential to the interpretation of his work. He has also recognised and acknowledged the fundamental importance of ideas of a mathematical or deductive nature. Thus, in the realm of his researches in crystal physics, he has realised the importance of group theory, and the theory of group representatations, and encouraged investigations based on such theoretical considerations. He has also shown facility in choosing the right type of mathematical technique needed in his work, and an uncanny faculty for seeing clearly through a mass of complicated mathematical calculations. His theory of the diffraction of light by high frequency sound waves is a striking example of this. Like all great physicists, however, he has placed facts first, and hypotheses always second.

Though the work of Raman and his school has lain in apparently diverse fields it is easy to discern a coherence and unity in them. The central and guiding theme of all his physical research has been optics in all its aspects. His special love has been for crystal physics, and in particular, physics of the diamond, in which subject he is a recognised authority. He has recently struck new paths in crystal physics, and introduced new concepts regarding crystal structure.

Another notable characteristic of Raman's scientific work is its sturdy individualism which is a consequence of the fact that when he started his career he belonged to no particular school of physics, but had to build one for himself. He is thus a true pioneer who has had the vision and courage successfully to explore unknown lands in physics. This circumstance has made him attach great importance to an independent approach to problems, and if his valuable example of striking out new and independent paths of research were to infect other scientific workers in our country, we are assured of a bright scientific future indeed. Further, the fact that he had to start work as an independent investigator without the facilities of an already well-equipped laboratory has brought out to the full his skill as an experimenter. Most of his experiments have required neither costly machinery nor any type of special techniques, but have been so simply devised as to be easily understood even by a layman. In fact, the apparatus with which he demonstrated the Raman effect is a model of simplicity and by no means a costly one, but nevertheless this simple experiment is one of the important milestones in the world's knowledge of nature.

It is perhaps not so well known that Raman has shown a fine æsthetic outlook in his research work. His choice of topics for investigation, and his way of handling them bring out clearly his innate artistic nature. His love of music, colour, light, vibration, symmetry, harmony, pattern, structure, and architecture is but the result of a deep appreciation of the beautiful in nature. His researches on musical instruments, numerous beautiful phenomena in wave optics, the colour of the sea, colour in the plumage of birds, iridiscent shells and mother-of-pearl, vibration in crystals, and above all his studies on the form, symmetry and structure of diamond based on fluorescence, phosphorescence and birefringence patterns are a but few examples of his æsthetic taste in research. He has one of the finest private scientific collections of diamonds and other beautiful crystals, and loves them as only a true artist can.

None who has come in contact with Raman can have failed to notice his very wide and catholic interest in many branches of science besides physics. He has perhaps done as much for chemistry as for physics. His interest in geology based on deep knowledge, especially in the fields of mineralogy and crystallography, has been a stimulant for the geological research of many workers in India. Some aspects of plant life, and animal life, specially birds, have always had a deep fascination for him. He has shown keen interest in and appreciation of astronomical and astrophysical research, both observational and theoretical. Indicative of his wide interests are his plans to build an astronomical observatory, a biological research unit and a mineralogical laboratory in the new Raman Research Institute. In spite of criticism from some quarters, it can be confidently claimed that by his collaboration and encouragement he has given the neces-

sary incentive to studies in mathematics even of the purest type. It is safe to say that there is no branch of science in which he has not encouraged creative and original work, and this augurs well for the development of fundamental research in the country in its new set-up.

Raman is not only a great investigator but also a great teacher in the true sense of the term. His ideas and personality have attracted many young research students, and he has held their loyalty and affection by extending a never-failing friendship to them. He has not only taught methods of physical research to his students, but by his own shining example made them realise the necessity for endurance, steadiness and hard work in the pursuit of knowledge. While giving help and encouragement in plenty, he has always expected and sometimes demanded from his students the best that they can give. The writer of this article has had many occasions to see the great care with which he would supervise the papers of his students, sometimes going to the extent of re-writing whole sections. No paper ever leaves his laboratory until he is completely satisfied with it.

The feelings of respect and admiration which his students have for him can be ascribed to his fairness and even generosity in acknowledging a pupil's ideas or originality. He is very liberal minded and gives away whole lines of research which lesser men would be tempted to keep for themselves. Whenever he discovers any originality in a pupil he will do all he can to develop it. His simplicity and informality are best seen in his discussions with students. Some penetrating remark made by him at such discussions has been the starting point, as some of his pupils have confessed, of a complete line of investigation undertaken by them later. This has been true not only in his own special field of research, but in other subjects as well.

Raman has rendered signal service to scientific advance in India as much by his contributions to knowledge as by his training of students in methods of research. He has exerted a profound influence on the work and outlook of not only his students but most of his contemporaries.

Unlike many scientific investigators who are giants in their own laboratories but dwarfs outside unable to take a due share in the national life of their country, Raman has fully participated in several walks of national activity, and is eager to serve the cause of scientific and technological advances in India. Possessing in a rare measure the extraordinary gift of making the most difficult problems in physics appear simple, and with a keen and irresistible sense of humour, he has admirably filled the role of an eminent popular lecturer on scientific subjects. Popularisation of science in the country owes not a little to his gifts of eloquence and exposition.

To have accomplished so much in one's own chosen field of research might have contented many men, but it is not enough for Raman. He has an unquenchable thirst for knowledge, and great energy for exploration, and for him "'Tis not too late to seek a newer world". On this occasion of his Sixtieth Birthday, we heartily wish him many more happy returns of the same with the hope that his vision and wisdom may well and truly serve the cause of science.

B. S. MADHAVA RAO.

---

## UNESCO BOOK COUPON SCHEME

IN a special ceremony at Unesco House on 1st Dec. 1948 the Acting Director-General, Gordon Menzies, delivered approximately $150,000 worth of book coupons to representatives of thirteen participating countries.

The Unesco book coupon scheme, devised to overcome foreign exchange difficulties, will enable educational and scientific institutions of "soft" currency countries to buy publications from "hard" currency countries, while making payment in their own national currency.

Of to-day's distribution, about $50,000 will be a donation by Unesco to Austria, China, Czechoslovakia, Greece, Hungary, Italy, Indonesia, Iran, the Philippines and Poland. The additional $100,000 worth of coupons will be put on sale in China, Czechoslovakia, France, India, Poland and the United Kingdom.

The coupon scheme, launched on a one-year experimental basis, practically amounts to the introduction of an international medium of exchange, with Unesco supplying the necessary "hard" currency backing to make the project work. Booksellers who accept those book coupons for payment will be repaid by Unesco in their respective national currencies.

The ceremony was attended by diplomatic representatives and guests from participating countries, the press and Unesco officials.

# INDIAN SOCIETY OF AGRICULTURAL STATISTICS

THE Second Annual General Meeting of the Society was held at New Delhi from the 23rd to the 25th of October, 1948. The meeting opened on the 23rd with a Presidential Address by Dr. Rajendra Prasad, President of the Society. Stressing the importance of correct and reliable statistics, Dr. Prasad said that accurate statistics formed the foundation of all our future planning. The work that the Society had undertakn was, therefore, of the highest national importance. He then referred to the progress already made in the methods of collection of agricultural statistics and said that the method of random sampling devised by statisticians for this purpose marked a great advance, and he was glad that the method was being extended to all the important crops in the country. Along with this question was also that of the cost of cultivation of crops which was equally important, and he urged statisticians to devote their attention to finding out the cost of production of the various crops and thus help the Government in their efforts to control and fix the prices of commodities. The work of the Society, he continued, would likewise be of value to the Government in their plan of giving aid to agriculturists in determining the extent of that aid and the method of distribution. Speaking of India's cattlewealth, Dr. Prasad said that the absence of accurate statistics was more pronounced in animal husbandry, especially because of the difficulties peculiar to that field. Yet, even there, one should not under-rate the need of having accurate information not merely of the number of cattle in the country, but of their individual worth. He then referred to the World Agricultural Census to be held in 1950, in which India had agreed to participate, and asked the statisticians to consider whether it could be carried out jointly with the population census without loss of efficiency.

Earlier, Dr. P. V. Sukhatme, Secretary of the Society, in his report of the year's activities, said that in the publication of a scientific journal, which was one of the Society's principal activities, they had to meet with great difficilties first for lack of funds and secondly for want of a suitable printing press equipped with mathematical and statistical types. He was, however, happy to place before the meeting a specimen copy of the first number of the Journal which had just been received from the press. A special feature of the Journal was the Hindi supplement giving summaries of the articles published in English. The Society had also prepared a glossary of Hindi equivalents of all principal terms in statistical science.

On the 24th October a symposium on the 1950 World Agricultural Census was held under the chairmanship of the Hon'ble Shri Jairamdas Doulatram, Minister for Agriculture, Government of India. The meeting was well attended by a number of statisticians and those interested in Agriculture from the Centre and the provinces. Emphasising the importance of the role of statistics in the formulation of economic planning, the Hon'ble Minister urged statisticians to devise ways and means of collecting statistics which were true, accurate and dependable; for, "no progress is possible in any field unless we are able to see the path we are treading or the goal we have to reach, and reliable statistics is the lamp that lights our path". Stressing the need of having a reliable census, he exhorted statisticians to produce statistics which for their accuracy and dependability could not be challenged and which will put India on a par with other countries in this field. He suggested that for this purpose the non-official element in the country should be mobilised to co-operate with and help the government in its task. This would help to remove suspicion and hesitation from the minds of the public and prepare the way for accurate results quite in contrast with the censuses of previous years which had been undertaken largely in an atmosphere of distrust and suspicion of the ruling class. In conclusion he suggested that a 'rehearsal census' should be held in 1950 as a preliminary to the census in 1951.

The main speakers included Messrs. W. R. Natu, Economic and Statistical Adviser, Ministry of Agriculture, Govt. of India, M. W. M. Yeatts, Census Commissioner, Govt. of India, Sir Shri Ram, Patron of the Society, Prof. J. N. Warner of the Allahabad Agricultural Institute, G. M. Sankpal, Director, Bureau of Economics and Statistics, Govt. of Bombay, Dr. N. S. R. Sastry, Reserve Bank of India, Bombay, and Dr. P. V. Sukhatme, Secretary of the Society.

Following the symposium a number of technical papers bearing on topics of interest to agricultural statisticians were read. Prof. K. B. Madhava was in the chair. The reading of papers was continued on the afternoon of the 25th of October with Mr. R. S. Koshal in the chair. The session concluded with a public lecture on the 'standardisation of agricultural products' by Dr. T. G. Shirname, Agricultural Marketing Adviser to the Government of India.

Among the messages of greetings received on the occasion of the Second Annual Meeting were those from Sir C. V. Raman, the noted Indian scientist, and the Hon'ble Shri. N. V. Gadgil, Minister for Works, Mines and Power, Government of India. Sir Raman in his message said:

"The enormous importance of the subjects falling within the purview of the Society can scarcely be questioned. The problems with which the Society is concerned are so essentially linked with agricultural practice and administration and their improvement that they cannot be divorced from these and regarded merely as a field for the application of the mathematical theory of Statistics. I find myself therefore in the heartiest sympathy with the points of view which the Society and its activities represent, and which you have so ably

advocated in the past. I am writing to send my cordial greetings to your President and members and my good wishes for the success of the meeting."

Sir Pheroze Kharegat was elected by the Society as its Honorary member as a mark of its appreciation of his services in the cause of Indian agriculture. Prof. N. G. Ranga was elected as an additional Vice-President of the Society during the year.

## INTERNATIONAL CONGRESS OF APPLIED MECHANICS

THE SEVENTH INTERNATIONAL CONGRESS OF APPLIED MECHANICS was held at the Imperial College, London, from the 5th of September to the 11th of September 1948 under the Presidentship of Sir Richard Southwell. About 800 delegates from all parts of the world attended it, and these included distinguished workers like Th. Von Karman, Sir Geoffery Taylor, Prof. S. Timoshanko, Prof. H. L. Dryden, Prof. W. Prager.

On the 5th of September the Governing Body of the Imperial College invited the delegates to an evening party. From the 6th to the 11th of September there were on each day two technical sessions and at least three general lectures. The Congress was divided into four sections in the following manner :—

*Section I.* Elasticity and Plasticity.
*Section II.* Aerodynamics, Hydrodynamics and Meteorology.
*Section III.* Thermodynamics, Heat Transfer, etc.
*Section IV.* Vibrations, Lubrication, Electronics, etc.

About 200 papers were accepted to be read in the four sections. Dr. B. R. Seth was the only Indian to read a paper. Sections I and II had each a sub-section. On the average about three papers were read and discussed in each session of about three hours. This is a very good practice and should be adopted by the Indian Science Congress Association and other scientific bodies. They should not accept all papers as a matter of course. A fairly comprehensive summary of all accepted papers was available before the session began, and in some cases even complete papers were given to the delegates.

In the first technical session of the Congress on the 6th of September the discussion on "Finite Elastic Deformation" was opened by Prof. L. M. Milne-Thompson of the Royal Naval College, Greenwich. He explained how the subject initiated by Dr. B. R. Seth in his paper published in the *Transactions of the Royal Society*, and developed by Prof. F. D. Murnaghan, could be extended to aelotropic bodies. Dr. B. R. Seth, commenting on the paper, gave practical examples where the theory as applied to aelotropic bodies, had been successfully worked out by him in a series of papers. Mr. R. S. Rivlin carried the discussion further. Prof. H. Bradenburger enquired whether the theory could be applied to explain why a member under tension did not behave in the same manner as when it was put under compression. Dr. Seth's work showed that it could be applied. Dr. H. K. Swainger gave his results for "severe deformation". Prof. A. Sigorini also gave some of his results.

Dr. B. R. Seth read a paper on "Bending of cylindrical shells with vertical walls". One of his results that the solution for the bending of a supported rectiliner plate under uniform pressure could be made to depend on the corresponding torsion solution was much appreciated by Prof. Milne-Thompson, Sir Geoffery Taylor and others.

It is difficult to give an account of all the papers that were read in the various sections. One can therefore mention a few of the important ones. Sir Geoffrey Taylor gave a paper on "Swirl Atomisers" and showed where the Engineers had gone wrong in the calculation of the boundary layer Th. Von Karman and Prof. C. C. Lin spoke on the theory of the turbulence and Prof. H. L. Dryden on the design of wind-tunnels.

Of the General Lectures delivered at the Congress one must mention the following :—

1. Recent developments in the Mathematical theory of plasticity by W. Prager.

2. Cinema aid in teaching mechanics, by L. Couffignal.

The technique adopted in the second was very good. It was a sound film on the kinematics of the universal milling machine.

On the social side there was a reception at the Senate House by the Vice-Chancellor of the University of London, an informal dance, reception by the Lord Mayor at the Guildhall and the Congress Banquet. The Indian Students' Hostel at Bayswater gave a dinner in honour of Dr. B. R. Seth. He gave them a talk on "Harnessing of Scientific Personnel in India".

A number of excursions were arranged for the delegates from the 13th to the 16th of September. Delegates visited the National Physical Laboratory, College of Aeronautics, National Gas Turbine, Royal Air-Craft Establishment and General Electric Co.

The Editor of the *Applied Mechanies Reviews* invited Dr. B. R. Seth to become a corresponding reviewer.

# WINTER RAIN IN THE UNITED PROVINCES

S. L. MALURKAR

(*Colaba Observatory, Bombay*)

IT is well known that the winter rain over North India is due to the passage of complex low pressure areas (called as western disturbances in India) under the influence of extratropical depressions.[1] These complex low pressure areas can be divided or broken up into a number of distinctly evolving simple low pressure areas each of which move almost ENE.[2]

While travelling between Delhi and Allahabad, it was noticed that *sometimes* the weather west of a place between Fatehpur and Cawnpore was dry and almost clear while to the east of the same place, the sky was mostly clouded and was occasionally threatening. Even the past weather of the places to the west of Cawnpore would have been dry. The secondary low pressure area which gave weather to the places east of Cawnpore got the moisture feed from more easterly longitudes.

The pre-monsoon period can also be included under the category of winter here.

The moisture-bearing winds are those that flow at or below 2 km. While the air at higher levels gives a dry feed and is responsible for instability weather. The more equatorward secondary low pressure area of a western disturbance affects only the lower heights[3] of the atmosphere which happen to be the moisture-bearing areas, the orography of the central parts of the country should be expected to exercise a directive influence on the weather. It is accepted generally that the effect of the mountains disappears at the height corresponding to two or three times the elevation of the mountain. With an orographic map, it should be possible to draw a sort of free stream lines to determine how the orography affects the weather. With an orographic map of India (0·5 and 1·0 km. contours) some free line curves were drawn (Fig. 1).

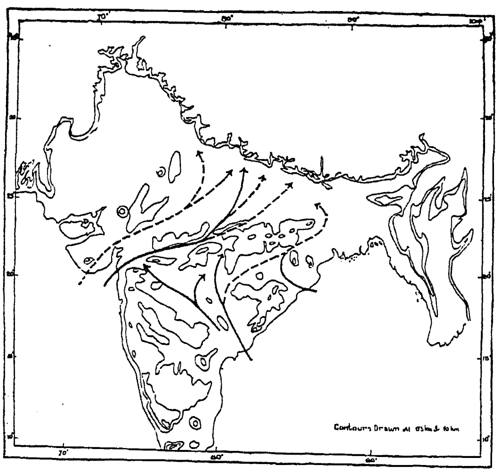


FIG. 1

The observations printed in the "Indian Daily Weather Report of the India Meteorological Department" and in the Provincial Raingauge Reports in the "Gazette of the United Provinces" were used to study in detail over a wide area and over a period of three to four days *prior* to the development of weather in the U.P. The rainfall recorded at the provincial raingauge stations were plotted against stations tabulated in the groups arranged SW to NE and could illustrate well the movement and evolution of the secondary low pressure areas.

Two typical instances were specially studied. In one, for 27th December 1945, Allahabad recorded one inch of rain. Stations in east U.P. had well distributed rain. In the west U.P., the rainfall was scanty or absent even on previous days. The sky at Delhi gave no indication of weather in the period.

In the second case, for 8th April 1946, fairly wide-spread dust or thunderstorms occurred in the east U.P. An airways pilot who flew from Gorakhpur to Lucknow on 8th afternoon saw a line squall following him. The mail plane pilot who left Allahabad to Delhi that evening said that he diverted to the south of Cawnpore and that he saw a line squall to the east of him.

*25th December 1945.*—0800 hrs. A low pressure area was over west Rajputana and Sind. There was hardly any clouding in the tract of the country covered by the stations Dwaraka, Bhuj, Deesa, Agra and Bareilly or in the tract covered by Jalagaon, Khandwa, Hoshangabad, Jubbulpore, Saugor (C.P.), Sutna and Allahabad.

The upper winds at 1·0 km. in the central parts of the Peninsula had changed since the previous evening. A 'natural' upper air stream line could be drawn from Madras to Bangalore and then northwards upto Ambala, so that a southerly flow which could ultimately be partly traced to the Bay of Bengal was possible. In N.W. India, a low pressure area was indicated in the upper air. The upper air along the west coast of India was determined by a high pressure area over the east Arabian Sea. A corridor of low pressure existed in the upper air at lower levels from south-west Peninsula to south Rajputana. The N.E. monsoon winds were moderate to strong in the southwest Bay of Bengal. The pressure change in the previous 24 hrs. and the pressure departure from normal were negative over northwest India but were not so over the United Provinces. It had rained 1½″ at Colombo and less than ten cents at Trincomalee and Hambantota in the previous 24 hrs.

1700 hrs. The northward upper air stream line that could be traced to the Bay of Bengal had shifted northwards: Masulipatam—Hyderabad and then northwards (due to the afternoon low?). The N.E. monsoon had slightly strengthened and gripped the winds at Madras and Bangalore. The area of negative pressure change and negative pressure departure had slightly moved over to the United Provinces. Otherwise, the conditions were the same as in the morning.

*26th December 1945.*—0800 hrs. Traces of low clouding could be observed west of Hoshangabad and Saugor (C.P.). The area of

negative pressure change was extending from the east United Provinces to Assam and it was positive in northwest India. The lowest pressure departure was in north Central Provinces, near Saugor and Jubbulpore. Less than ten cents of rain had fallen at Nowgong, Sutna, Allahabad, Benares and Alleppy. It was still raining at Allahabad and Benares. Allahabad had an easterly and Benares had a northwesterly wind (force 2).

In the upper air at 1·0 km., the northward stream line which could be traced to the Bay of Bengal was again Madras-Bangalore-Hyderabad and then northwards. The upper winds at Bombay, Nagpur and Jubbulpore were SSW and strong at 1·5 and 2·0 km. and gradually veered to west at higher levels. Bhopal had also strong SSW upper winds. A low pressure area in upper air (at 1·0 to 1·5 km.) was over northwest Central Provinces and east Central India.

From the *Provincial Raingauge Reports*: Mau in Jhansi; Rath; Madha and Khajwa in Hamirpur; Banda, Girwan and Baberu in Banda districts; and Fatehpur and Lucknow recorded light rain to the west of Allahabad. There was no rain at the more westerly stations recorded either on 26th or on preceding days.

1700 hrs. Allahabad had a thunderstorm. The belt of negative pressure change had moved further east.

*27th December 1945.*—0800 hrs. Pressure change in the previous 24 hrs. was positive all over the country, outside Chotanagpur. Orissa and parts of Bengal and Assam. Pressure departure was positive over the central parts of the country.

At 1 km. the upper air stream line which could be traced to the Bay of Bengal was Masulipatam—Sambalpur—Gaya and Gorakhpur. An upper air low could be seen over the east United Provinces and West Bihar. Past weather: Lucknow had less than ten cents rain. Bahraich ½″, Sutna ¼″, Allahabad 1″, Gorakhpur ¼″, Benares ½″ and Gaya ¼″.

From the *Provincial Raingauge Reports*, arranged according to districts lying in groups southwest to north east:

One station out of four recorded very light rain in Sitapur, 3 out of 9 stations had rain in Banda, 1 out of 4 in Gonda and 2 out of 3 in Bahraich districts, 1 out of 3 in Fatehpur, 1 out of 4 in Rae Bareli, 1 out of 6 in Fyzabad and 2 out of 3 in Pertabgarh districts; 8 stations out of 8 in Allahabad, 5 out of 5 in Jaunpore, 6 out of 6 in Basti, 5 out of 6 in Azamgarh and 5 out of 8 in Gorakhpur districts; 1 station out of 5 in Mirzapur, 2 out of 3 in Benares, 3 out of 4 in Ghazipur and Ballia districts recorded rain.

*7th April 1946.*—0800 hrs. A low pressure area was over west Rajputana and Sind East of Long. 77° E and north of Lat. 13° N, even the surface winds had a southerly component. It was raining over Assam and north Bengal. It had rained in the western Himalayas and in the S.W. Peninsula. Minimum temperatures were below normal in the southeast United Provinces.

In the upper air at 2·0 km., a low pressure area could be detected extending from the northeast Punjab to east Central India and the northeast Central Provinces.

From the *Provincial Raingauge Reports*, it is seen that Pharendra in Gorakhpur and Deoria in Deoria (formerly part of Gorakhpur Dist.) districts had each 2″·92 rain. On the 6th, fairly widespread rain had been recorded in Ballia, Deoria, Gorakhpur and Basti districts.

1700 hrs. Skies were clear at Benares and Allahabad. They were partly clouded at Guna, Saugor (C.P.), Jubbulpore, Sutna and over Chota Nagpur. At 1·0 km. in the upper air, there was a low over east Central India and adjoining districts of the United Provinces. At higher levels the westerlies were running over the whole of the United Provinces.

*8th April 1946.*—0800 hrs. The low pressure area on the surface chart extended from north Rajputana to the southwest United Provinces. Surface winds continued to show southerly east of Long. 78° E. Skies were partly clouded at Allahabad, Sutna and Nowgong. Delhi was overcast and it had rained in the past hour. It was still raining in Assam and north Bengal. Over the rest of Bengal, skies were partly to mostly clouded. Near the United Provinces, among the departmental observatories, only Nowgong reported rain. Minimum temperatures had risen in the east United Provinces.

Upper air flight at 0900 hrs. at Allahabad gave easterly to east-southeasterly upto 1·5 km. Bareilly was strong east to southeast upto 1·5 km. An upper air low, extending upto a height of 1·5 km. above sea level, was over the United Provinces, the southeast Punjab and north Rajputana.

From the *Provincial Raingauge Reports*. Three out of six stations in Cawnpore district had rain (each more than 0″·38), 1 out of 4 had very light rain in Mirzapur district. No other station in the plains of the U.P. recorded any rain.

1700 hrs.—A low pressure area was over the north Central Provinces and east Central India caused partly by the afternoon heating. A high pressure area was enclosing Daltonganj and Hazaribagh which were having thunderstorms at time. Allahabad reported thunder. Cawnpore and Mainpuri had recorded dust or thunderstorms. Agra had a drizzle.

According to newspapers, thundersqualls and dust storms occurred over a wide area from Fatehpur to Benares.

The thick clouding approached Allahabad from west-north-west. It broke out with a severe duststorm at Allahabad at about seven O' clock in the evening and was over Bamrauli about 20 minutes earlier.

*9th April 1946.* From the *Provincial Raingauge Reports*, it is seen that rain was recorded in 3 out of 4 stations in Ballia, 4 out of 4 in Ghazipur, 3 out of 3 in Benares, 2 out of 4 in Gorakhpur, 3 out of 5 in Deoria, 3 out of 6 in Azamgarh, 2 out of 4 in Jaunpore, 4 out of 5 in Mirzapur, nil in Allahabad, 1 out of 5 in Basti, 1 out of 6 in Fyzabad, 2 out of 3 in Fatehpur, one out of 4 in Sultanpur, 1 out of 8 in Hamirpur, 4 out of 9 in Banda and 1 out of 4 in Jalaun districts.

The main lines of argument and conclusions, are given here.

In the first example 27th December 1945, most of the rain fell to the east of the line drawn from Fatehpur to Basti or Gorakhpur. The pressure changes on the weather chart show the eastward passage of a low pressure area which was over Sind and W. Rajputana on 26th and its secondaries. These produced little precipitation in the plains until they had a S-ly feed from regions east of Long. 77° E. In the northern hemisphere a northward moving air stream has latitudinal convergence and tends to become less stable in its mass. If other conditions are suitable, weather is produced. An air stream with a good sea travel, after only a small northward displacement in a given amount of time may cause clouding and even precipitation. Stream lines on 25th and 26th had a run from Madras to Bangalore and then northwards but were not moist enough to give rain in the Central Provinces. The N.E. monsoon was moderate to strong in S.W. Bay of Bengal and an infeed of N.E. Trades occurred into the above stream lines; activating some particular secondary low.[4] The S-ly feed was not deep and above 2 km. the winds were W-ly. These higher level winds could be associated with the rear of a low of a western disturbance at a higher latitude and would be bringing in fresh cold air at higher levels. In fact, *the strengthening of the westerlies at higher levels can be taken to usher in colder days in winter over N.W. India and in the U.P.*

Fresh incursion of air at higher levels, colder than what existed there previously would decrease the stability in the air along the vertical. The fresh incursion of the S-ly air at lower levels bringing in more moist and warmer air than what existed previously has also a similar effect on stability. Along with latitudinal convergence, the air, now at the locality, can well maintain convection, if once started.[5] The causes of initial vertical movement in the production of thunderstorms are one or more of: (*a*) the 'cold front' of these secondary low pressure areas. It is well known that after the thunderstorms in winter the wind shifts to a W-ly or N.W-ly direction from its previous E. or SE. Each secondary has its own wind shift and it is only after the wind shift occurs that drier and cooler days set in. (*b*) Orography. (*c*) Wind velocity gradient which express the same condition in more general terms. (*d*) The unequal heating or insolation or (*e*) the long period oscillations of the isopycnic surfaces.[5]

In April 1946—usually a dry season in the plains of the U.P.—the plains of the west U.P. had little rain. The moist feed came from longitudes further east than on December 26th 1945. The secondary low pressure area was only detectable below 2 km. It was raining in Assam and N. Bengal and thunderstorms had occurred in S. Bihar and Chota Nagpur. Stream lines at lower levels passing over these regions would be moist. At higher levels, the rear of more northerly low pressure area of a western disturbance was exercising its influence, *i.e.*, it was bringing in fresh cold air at higher levels. Hence the vertical structure of air was favourable to maintain convection. The causes of initial convection are the same as before except that insolation plays a greater part as summer is approaching. When the secondary low pressure area (with a small vertical extent and which was responsible for bringing into juxta-position of different air streams) passed ENE wards; the weather in the east U.P. cleared up till the next cycle of secondaries appeared.

Fig. 2 represent diagrammatically the vertical structure of air mass before dust or thunderstorms.

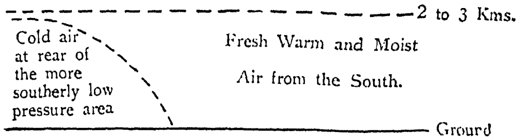



FIG. 2

(Thunderstorm in the U. P. in winter)

Fresh Cold Air at the rear of a Northern Low Pressure Area of a Western Disturbance

If at higher levels, cold air does not establish itself as shown by strong W-ly winds, the weather does not clear up completely and heat thunderstorms result.[6]

With an extensive chart, it is possible to watch the successive secondary low pressure areas. When the weather chart *is limited*, some working criteria had to be evolved based on the above and Fig. 1.

*If a western disturbance was passing over 30° N, rain or clouding in the tract east of the Aravallis and west of the Vindhyas (represented by the observatories Dohad, Brijnagar and Jhansi) would show that a secondary low had a moisture feed and in its east-northeastward passage, it would be a pre-indication of weather in the west U.P. and neighbourhood.*

*Rain or clouding in the tract represented by the observations from Indore, Khandawa, Hoshangabad, Saugor, Jubbulpore and Sutna show that the secondary low further south than in the previous instance has had a moisture feed. This secondary, during its course of movement ENE wards would give weather in the east U.P. and neighbourhood.*

The orography must also be kept in view.

If the secondary low pressure area has more closed isobars than usual, due to the anticlockwise motion of the winds round it, the moist stream would extend to more westerly longitudes and give weather there than if the low was weak.

For the east U.P., a southerly feed would come from longitudes east of Long. 78° E or 80° East. The upper winds of Bangalore, Hyderabad (Deccan) and Nagpur become significant. At lower levels, the upper winds from the more southerly stations must show a *SE component*, while those from higher latitudes must a *SW component*. In early summer, the seasonal low gets to be more marked. Then the *SE-ly components of winds on the east coast stations become significant*, *i.e.*, at stations like Madras, Masulipatam, Vizagapatam, etc.). Sometimes, if Assam and Bengal be raining and a shallow low pressure area is found over east Central India, the belt

of thundershowers would extend from NE India even into the U.P. and these would be more marked in the eastern districts.

A weather forecaster is very much interested in the time sequence between the starting of SE-ly components in upper winds at places east of Long. 78° E. and along N. Madras coast and the subsequent weather in the east U.P. I have been unable to collect statistics. The changing of the wind directions to SE-ly on the east coast of India, the weather in the east U.P. and Chota Nagpur may be contemporary happenings of the weather pattern. It may not be logical to count the time interval *after* the setting in of the SE-lies. The pressure departure chart may be a better indicator. When a wave of a negative pressure departure passes eastwards across the country, this may be taken as an indicator of the passage of the low pressure area of the western disturbance. This low would some times induce the SE lies. However, an interval of 24 to 36 hours can be assumed to be the approximate time between the starting of SE-ly upper winds at lower levels east of Long. 78° E. and weather in the east U.P.

A comparison of the periphery of the rain belt with the free line curves drawn in Fig. 1 is quite close. Such instances can be easily multiplied. It is hard to determine theoretically the fanning out of the moist stream by orography of the central parts of the country. It should be possible, however, to carry out a model experiment in a tank or in a wind tunnel.

*Squalls near Jubbulpore.* Jubbulpore is situated at the crossing of two valleys formed by 0·5 km. contours (SW to NE and nearly SE to NW). The moist feed is directed along either of the valleys to the south of the place. When a 'cold front' of a low pressure area of a western disturbance passes to the north it brings in westerly or northwesterly winds. Owing to a sort of funnel effect of the valleys, more moist and more cold air are put into juxta-position and produce thunderstorms of more than usual intensity in the neighbourhood. The squalls produced in the pre-monsoon months at Jubbulpore are more severe than in many places in the Central Province; and tornadoes also occur occasionally (*vide* May 1936).

---

1, 2 and 3. Malurkar, "Forecasting Weather In and Near India," 1945, Bangalore, p. 102; Malurkar, Technical Note No. 1, p. 3. *Ind. Met. Dept.*; *Curr. Sci.*, 1947, **16.** 139, and 1948, **17.** 112, and under 1 see also Mal and Desai, *Technical Note No.* 25. *Ind. Met. Dept.*, 1947. 4. Malurkar, *Curr. Sci.*, 1947, **16,** 139. 5. —, *Proc. Ind. Acad. Sci.* (*Bangalore*), Sec. A 1943, **18,** 20, and 23. 6. —, "Forecasting weather etc." *loc. cit.*, p. 112.

*Note*—The cost of printing this contribution has been defrayed by a generous grant from the Rockefeller Foundation for the publication of results of scientific work made to us through the kindness of the National Institute of Sciences, India—*Ed.*

## UNIVERSITY INTERCHANGE BETWEEN U. K. AND INDIA

To facilitate interchange between the universities of the United Kingdom and those of India, Britain is arranging for a number of travel grants.

The awards will be made on the recommendation of a Committee composed of representatives of the Association of Universities of the British Commonwealth, of the Committee of Vice-Chancellors and Principals of the U.K., and of the Universities Advisory Committee of the British Council.

Recipients will fall under three categories: distinguished scholars and scientists invited by universities for visits of at least 6 weeks' duration to enable them to meet fellow specialists and to mix with rising young workers in their own fields; university teachers on recognised study leave; and post-graduate research workers holding research grants. The latter two categories must undertake to spend at least 6 months of the academic session at the university where they propose to work.

Conditions for eligibility for university teachers and post-graduate research workers include suitable academic qualifications and experience, and a definite programme of work. The university named by the applicant as his proposed place of study must also be willing to receive him.

### Applications

Applications are to be sponsored by the applicant's own university, and, in the case of university teachers, backed by the necessary finances—not less than 6 months' leave of absence on full pay. Post-graduate research workers are required to maintain themselves fully, while distinguished visiting scholars and scientists receive the necessary hospitality and costs of travel within the country from the inviting universities.

Grants are equivalent to the average cost of a return sea passage. For scholars and scientists invited by universities, passage may be arranged by air, depending on circumstances. Grants are normally paid in the U.K. in sterling, but in cases of necessity special arrangements may be made to pay part of the grant before sailing.

Particulars of visits which it is desired to arrange for distinguished scholars and scientists are to be sent by the inviting university to the Secretary, Committee for Commonwealth University Interchange, c/o The British Council, 3, Hanover Street, London, W.1. Persons in the other two categories are to send three copies of their application to the Vice-Chancellor or Principal of their own university for forwarding. January 31, 1949, has been fixed as the last date for the guaranteed consideration of applications, and the announcement of awards is expected to be about the end of March.

The most important thing is that this scheme provides for two-way traffic: facilities are provided both for Indians to visit the United Kingdom and for British scholars to undertake research and meet their colleagues in India.

# SOME REACTIONS OF p-CYMENE

JAMES VERGHESE

P-CYMENE, 1-methyl-4-isopropyl benzene, is a common constituent of many essential oils. Sulfite turpentine is particularly rich in this hydrocarbon. Several methods mostly covered by patents are also available for its cheap production from readily available terpenes by vapour and liquid phase dehydrogenation.*

As a substituted benzene, p-Cymene is amenable to varieties of chemical transformations, thus constituting a potential raw material for the chemical industry. It is with this view, many of its more important oxidation, resinforming hydration and thermal fission reactions are now discussed.

## (A) OXIDATION REACTIONS

(*i*) *Electrolytic Oxidation:* Fitcher and Meyer[1] showed the intricate course of this reaction, having isolated 4-isopropyl benzaldehyde, 4-aceto-benzoic acid and terephthalic acid in one set, and 4-isopropyl-benzyl alcohol, 4-isopropyl- and 4-propenyl-benzoic acids, and probably diisopropyl-benzyl ether, in a second set of experiments.

(*ii*) *Vapour Phase Oxidation:* Senseman and Stubbs[2] isolated mostly 4-toluic acid (max. yield, 16·9% at 375° with sp. velocity 300 and 3-6 times the amount of air), besides terephthalic and formic acids, formaldehyde, carbon dioxide and water, using vanadium pentoxide deposited on porcelain as a catalyst. It appears >CH- group of the side chain is most readily attacked by this means.

(*iii*) *Liquid Phase Oxidation:* According to Stephens,[3,4] oxygen attacks the isopropyl group of the hydrocarbon in the absence of any catalyst at 80°-100°, resulting in the loss of one methyl group as formic acid or carbon dioxide and water, with the formation of 4-tolylmethyl ketone. Oxidation of 1-methyl group also leads to 4-isopropyl benzaldehyde and benzoic acid.[4] However, in presence of finely divided manganese dioxide or manganese 4-toluate,[5] at 140°-160°, 4-toluic, terephthalic and formic acids, formaldehyde, 4-tolylmethyl ketone, carbon dioxide and water are produced. Oxides of chromium, cobalt, iron, nickel and copper act as promoters. The non-formation of alcoholic products in this reaction is rather striking. On the other hand, Palmer and Bibb[6,7] point out that oxidation in presence of a catalyst like a mixture of manganese and lead acetates, at 30°-50°, 40% conversion to 4-isopropyl benzoic acid[6,8] is obtained. This is by far the best method for the production of this acid.

According to Tunghna Kuan,[9] 4-tolylmethyl ketone (I) is obtained in 51% yield on oxidation with nitric acid (2 mols; d=1·12), but Hintikka[10] who used 4 parts of nitric acid (d=1·41) and 5 parts of water, could isolate only 10% of this ketone (I) besides 67·5% 4-toluic acid, 5% terephthalic acid and 16·5% nitro-compounds. It may be noted that styrenes like 4-methyl, and 4-α-dimethyl styrenes could be readily obtained from (I) by appropriate chemical reactions,[10] *via* the carbinols, but from a practical operative standpoint it would be economical to produce these styrenes and the carbinols directly from p-Cymene (see under Thermal fission) In this connection the experiments of Palmer and Bibb[6] are of interest. If oxidation by air is carried out at low temperatures below 50°, in presence of manganese and lead acetates, hydroxides or salts of a heavy metal of an organic acid as catalyst, αα-dimethyl-4-tolyl carbinol and 4-tolylmethyl ketone (I) are formed[8] which can be recovered after dehydration as the styrene and the ketone (I) by fractionation. All these products are of commercial significance. The ketone (I) is a good soap perfume and the styrene (4-α-dimethyl styrene) possesses analogous polymerising properties as the ordinary styrene, in yielding tough, colorless resins.[6] The carbinol which has a higher boiling point than α-terpineol, possesses good wetting properties suggesting its substitution for pine oil when higher alcohol content is desired. The styrene itself can readily be obtained by dehydration in presence of active carbon or graphite,[11] and this forms polymers and co-polymers,[12,13] by heat, cold con. sulpuric acid and benzoyl peroxide.

## (B) RESIN FORMATION, HYDRATION AND THERMAL FISSION

(*i*) *Resin-forming Reactions:* Useful resins could also be obtained directly by chlorination of p-Cymene at temperatures above 100° in presence of Al, Fe or Zn, the cymyl chloride formed *in situ* undergoing a self Friedel-Crafts reaction, resulting in the formation of a dimer. The resins thus obtained however generally contain 10-30% chlorine (probably by nuclear chlorination and other causes).[14]

Varieties of resins can be obtained by previously incorporating other ingredients with p-Cymene. Addition of o-dichloro benzene gives a resin of higher chlorine content with added resistance to weather and water compositions. Inclusion of naphthalene produces a harder resin which is not readily attacked by petroleum distillates.[14]

These resins are insoluble in acids, alkali and ethyl alcohol and are not affected by hot 15% sodium chloride solution. Coating compositions derived from such resins could be used with advantage in marine work and chemical plants, in the treatment of railroad ties and telephone poles. Stains, varnishes, and lacquers have been prepared from these resins using o-dichloro benzene and p-Cymene as thinners. Satisfactory black, pliable coating composition can also be prepared without the use of extraneous pigments. These resins cannot be brought to the infusible state by heat and pressure treatment.[14]

(*ii*) *Hydration:* A simple, elegant and remarkable catalytic hydration of p-Cymene of great technical importance has recently been discovered by Schwartz.[15,16,17] In essence, it involves the saturation of the three double bonds resulting in camphor in a rather unusual manner.

The catalyst recommended is a mercury compound, *e.g.*, HgO or $HgCl_2$, or fatty acid salt, *e.g.*, sodium stearate, and the reaction is preferably carried out in a mutual solvent, *e.g.*, methyl alcohol, and at temperatures

* In this country from Indian Turpentine Oils.

above 35°, particularly at the boiling temperature. Modifications of the process consist in carrying out the reaction under 10 atmospheres pressure in the absence of solvent, and also in vapour phase.

(*iii*) *Thermal fission*: Cracking *p*-Cymene at 300°-450° with activated bleaching earths produce toluene and propylene,[18] *e.g.*, with 'tonsil' and at 420°, 60·5% toluene, besides 10% unchanged *p*-Cymene, saturated hydrocarbons (1·6%; b.p. 50°-60°, and 2%; b.p>180°) and 25% gas (80% propylene) is obtained.[19] Other methods[20,21] cover the production of toluene and propylene using a catalyst comprising of alumina and silica.

Selective elimination of a methyl group from the isopropyl residue as methane has been effected by Ostromisslensy and Shepard[22,23] by passing the hydrocarbon admixed with carbon dioxide through a tube at 650°: 40-50% yield of 4-methyl styrene is thus obtained. This is further investigated in detail by Breneck and Muller[24] who used iron, copper and aluminium catalysts. It is possible under suitable conditions to obtain 62% conversion into the styrene.

The selective dehydrogenation of *p*-Cymene into 4-α-dimethyl styrene achieved by Balandin and co-workers[12] is a recent contribution to the subject and marks an important advance. At 625°, with vanadium pentoxide as a catalyst, optimum conversion (63·4%) into the styrene takes place in presence of two mols of carbon dioxide. Improvements[25] of this process consist of reducing the partial pressure of *p*-Cymene by mixing with carbon dioxide and carrying out the reaction at reduced pressures and at lower temperatures, *e.g.*, 500°.

*Conclusion*: The utilisation of *p*-Cymene in the past for the production of synthetic thymol and menthol is well known. As indicated above, varieties of products could be obtained from *p*-Cymene, and it is hoped that this review will stimulate further investigations on the commercial utilisation of this important raw material for production of many useful substances.

1. Fr. Fitcher and Jacques Meyer, *Helv. Chim. Acta.*, 1925, **8**, 285. 2. C. E. Senseman and J. J. Stubbs, *Ind. Eng. Chem.*, 1931, **23**, 1129. 3. H. N Stephens, *J. Amer. Chem. Soc.*, 1926, **48**, 2920. 4 H. N. Stephens, *ibid.*, 1926, **48**, 1824. 5. C. E Senseman and J. J. Stubbs, *Ind. Eng. Chem.*, 1932 **24**, 1184. 6. R. C. Palmer, *ibid.*, 1942, **34**, 1028 7. R. C. Palmer and C. H. Bibb (to Newpor Industries, Inc.), *U. S. Pat.*, 1942, 2,302,462. 8. —,— (to Newport Industries, Inc.), *Ibid.*, 1942, 2,302,466. 9. Tunghna Kuan, *J. Chem. Soc. Japan*, 1931, **52**, 800. 10. S. V. Hintikka, *Ann. Acad. Sci. Fennicæ.*, 1923, **19A**, No. 10, 6. 11. R. C. Palmer and C. H. Bibb (to Newport Industries, Inc.), *U. S. Pat.*, 1944, 2,345, 625, 12. A. A. Balandin, G. M. Marukayan and R. G, Seimovich., *Compt. rend. acad. Sci. U. R. S. S.*, 1943. **41**, 67. 13. James K. Dixon (to American Cyanamid Co.) *U. S. Pat.*, 1945, 2,376,310. 14. P. H. Groggins., *Ind. Eng. Chem.*, 1928, **20**, 597. 15. F. Schwartzt *U. S. Pat.*, 1945, 2,389,389. 16. F. Schwartzt *Brit. Pat.*, 1943, 554,636. 17. —, *Swed. Pat.*, 1947, 118,286; *Chem. Abstracts*, 1948, **42**, 222. 18. Karl Schollkope, *U. S. Pat.*, 1929, 1,747,604. 19. Rheinische Kampfer-Fabrik, G. M. B. H., *Ger. Pat.*. 1928, 483,640. 20. Kungl Armeforvaltningens Artilleri Department (K. E. Skarblom, inventor', *Swed. Pat.*, 1935, 84,830; *Chem. Abstracts*, 1936, **30**, 6389. 21. G. Ljunggren (Försvarsväsendets Kemiska Anstalts Forskningslab., Stockholm). Finska Kemistsamfundets. *Medd.*, 1945, **54**, No 1/2, 12; *Chem. Abstracts*, 1947. **41**, 3684. 22. I. Ostromisslensky and M. G. Shepard (to Naugatuck Chemical Co.), *Brit. Pat.*, 1924, 232, 909. 23. I. Ostromisslensky and M. G. Shepard, *U. S. Pat.*, 1924, 1,552, 875. 24. Hans Breneck and Hans Friedrich Muller, *Ber.*, 1942, **75B**, 554. 25. A. A. Balandin, G. M. Marukayan and R. G. Seimovich, *U. S. S. R. Pat.*, 1945, 64,222; *Chem. Abstracts*, 1946, **40**, 4715.

## OSCAR EDWARD MEINZER*

IN the passing away of Dr. Oscar Edward Meinzer, the world has lost an eminen Geologist and a great authority on Ground-Water Hydrology. His famous treatise "The Occurrence of Ground Water in the United States with a discussion of Principles" published as Water Supply Paper No. 489 by the U. S. Geological Survey in 1923, and his numerous other papers on Hydrological investigations, specially on ground-water problems, contributed to the Governmental publications and Scientific and Engineering Journals, constitute a series of valuable references to Geo logists and Hydrologists all the world over.

Dr. Meinzer was born on November 28, 1876, and hailed from a country farm in the State of Illinois. After a distinguished career at the College, he entered the U. S. Geological Survey in 1906 where he served for 40 years until his retirement in 1946. Through these long years of patient and able work, Dr. Meinzer has systematized the knowledge of the occurrence and principles of recovery through wells and springs of the supplies of water which are hidden in the rock formations. He was the leader in the development of ground water for useful purposes. He investigated the Geology and ground water resources in the arid valley regions of the Western States of U. S. A. These valleys were then sparsely populated or desert areas, but have since become prosperous through irrigation from wells developed as a result of his investigations.

Dr. Meinzer was a member of numerous scientific societies. He was the past President of the Society of Economic Geologists, and the Washington Academy of Sciences, and other institutions. At the time of his death he was the President of the American Geophysical Union. He had been awarded the William Bowie Medal in 1943.

Dr. Meinzer was a man of varied interests. He was a student of Philosophy and maintained a searching interest in Religion.

It is reported that Dr. Meinzer was apparently in good health and spirits upto the day of his death, June 14, 1948, when he quietly passed away during an afternoon nap. Thus came the peaceful end of a great career.

M. B. R. RAO.

* Published with the permission of the Director, Mysore Geolgical Department. A detailed Obituary Notse has been published on the opening pages of the *Transactions of the American Geophysial Union.*, August 1948, **29**, No. **4**. from which the material for this hort noter hos been obtained.

# LETTERS TO THE EDITOR



## A NOTE ON THE RELIABILITY OF TESTS*

RELIABILITY AND VALIDITY are two of the most important aspects of psychological tests (Intelligence Tests and Aptitude Tests, etc.). The most common method utilized to evaluate the reliability of tests is the split-half method.[1] The test is split into two halves in some way (*e.g.*, the odd items forming one half and the even ones the other half) and the coefficient of correlation between scores on them is worked out. This cœfficient is taken to be a measure of the reliability of the test, and is defined as the reliability-coefficient of the test.

But there is a certain amount of arbitrariness in this method, in the sense that the splitting can be effected in more than one way. Actually there are $n/2\left(\frac{n}{2}\right)^2$ different ways of splitting a test of $n$ items into two halves. Each of these ways of splitting the test gives its own estimate of the reliability-coefficient of the test, and there is no reason to suppose that each of these estimates must be the same. Hence for a test of $n$ items the reliability coefficient worked out by one arbitrary splitting process is only one value chosen out of $n/2\left(\frac{n}{2}\right)^2$ values lying near it.

To rectify this defect in the split half method Messrs. Kuder and Richardson[2] worked out a method which leads to unique values of the reliability-coefficient. Their formula is

$$r = \frac{n}{n-1}\left(\frac{\sigma^2 - \Sigma pq}{\sigma^2}\right)$$

where

$r$ = reliability of the test
$n$ = number of items in the test
$\sigma$ = standard deviation of the test
$p$ = proportion of subjects passing my item
$q$ = I-p
$\Sigma$ = Summation taken over all items in the test.

We can now put a lower limit to the value of the reliability-coefficient of tests. For, suppose there are 100 items in a test, and suppose at worst the scores lie between 50 and 98 (a pretty narrow range); then because of normal distribution of scores, the standard deviation $\sigma$ can easily be assumed to be about 8. Further the greatest value of $pq = ¼$. Hence the Kuder-Richardson formula gives

$$r > \frac{100}{99}\left(1 - \frac{100}{4 \times 8 \times 8}\right),$$

which is $> 0 \cdot 5$ .

*Hence a test of fairly big size, whose reliability-coefficient is less than 0·5, is not good for use and must be rejected.*

Although from theoretical considerations Kuder-Richardson formula is an improvement over the split-half method; yet its application in actual practice is a time-taking matter; for the term $\Sigma pq$ takes long to be evaluated. It would be welcome, therefore, if we could work out a formula which gives the reliability quickly even though approximately.

In the Kuder-Richardson formula let us replace $\frac{n}{n-1}$ by unity, and take $\sigma = \frac{n}{6}$. The value of $pq$ lies between 0 and ¼, so that $\Sigma pq$ may be taken to be $\frac{n}{6}$. With these assumptions the reliability

$$\tau = 1 - \frac{n/6}{(n/6)^2} = \frac{\sigma - 1}{\sigma},$$

for $\frac{n}{6} = \sigma$.

This formula is independent of the term $\Sigma pq$ and is, therefore, very quick in giving the reliability of tests. It may be noted that bigger the size of the test, better will be the approximation given by this formula; for bigger is $n$, nearer to 1 is $\frac{n}{n-1}$.

For purposes of verification I have already applied the formula elsewhere[3] and found that the approximation given by this formula is correct upto the first place of decimal. Such an approximation is often quite satisfactory as far as reliability coefficients are concerned.

Ministry of Education, P. D. SHUKLA.
Government of India,
Simla,
*September* 19, 1948.

1. Garret, H. E., *Statistics in Psychology and Education*, 1946, p. 313. 2. Kuder, G. F. and Richardson, M. W., The Theory of the Estimation of Test Reliability" *Psychometika*, 1937, **II**, **3**, 151–60. 3. Shukla, P. D., "Some Statistical Studies about Civil Selection Boards Abstract," *Proc. Indian Sci. Congress*, Delhi, 1947.

* This note was read in the Indian Science Congress Session at Patna, in January 1948.

While considering the Kuder-Richardson formula

$$\tau = \frac{n}{n-1}\left[\frac{\sigma^2 - \Sigma pq}{\sigma^2}\right] \qquad (1)$$

the author suggests that we can assume that $\frac{n}{n-1}$ approaches unity as $n$ becomes larger and larger and also that we can replace $\sigma$ by $\frac{n}{6}$ and $\Sigma pq = n/6$. The value of $pq$ lies between 0 and 1/4 and the reasons for assuming $\Sigma pq = n/6$ is not very clear, apart from the arithmetical ease in the further simplification of (1). Since in (1) the term $\Sigma pq$ is subtracted, it is better if we assume the maximum value of $\Sigma pq = n/4$ and proceed as suggested in this paper. The value of $\tau$ on simplification becomes the minimum and the formula (1) reduces to

$$\tau = \frac{\sigma - 1\cdot 5}{\sigma}.$$

If this value of $\tau$ can be assumed to be reliable, it will be so whatever be the values of $p$ and $q$, while the simplifications suggested by the author will be reliable only when $0 < \Sigma pq < n/6$. Besides, this new formula has got all the advantages which is claimed by the author for his suggested formula.

M. C. S. AND N. S. N.
Bangalore,
*October* 19, 1948.

## ON EINSTEIN'S GENERALIZED THEORY OF GRAVITATION

A PAPER, bearing the same title as the present communication, was recently communicated by us to the National Institute of Sciences of India. We have discussed in it the field equations of the generalized theory* and outlined a method of successive approximations for working out the interaction between a gravitational field and an electromagnetic field. The computation of interaction terms is an extremely laborious task and, so far as we know, has not been carried out yet. The results that are given below seem to be new and of considerable interest.

The theory is based on a Hermitian tensor $g_{ik}$:

$$g_{ik} = a_{ik} + \sqrt{-1}\,b_{ik},\ a_{ik} = a_{ki},\ b_{ik} = -b_{ki}. \qquad (1)$$

We consider a pure gravitational field as given by

$$a_{11} = a_{22} = a_{33} = -(1+m/2r)^4,$$
$$a_{44} = (1-m/2r)^2\,(1+m/2r)^{-2},\ a_{ij} = 0,\ i \neq j \qquad (2)$$

and a pure electromagnetic field as given by

$$b_{13} = b_{34} = \phi,\ b_{12} = b_{14} = b_{23} = b_{24} = 0,$$
$$\phi \equiv A \cos\frac{2\pi}{\lambda}(x-t), \qquad (3)$$

in the usual notation. In the complex field unifying the two $a_{ij}$ is modified by $\phi$ and $b_{ij}$ by $m$. The exact nature of the interaction of the two fields is certainly very complicated. Our computations show that the usual Maxwell equations are modified as follows:

$$\begin{aligned} -\frac{\partial E_z}{\partial y} + \frac{\partial E_y}{\partial z} - \frac{\partial H_x}{\partial t} &= \frac{2\phi mz}{r^3}, \\ -\frac{\partial E_x}{\partial z} + \frac{\partial E_z}{\partial x} - \frac{\partial H_y}{\partial t} &= 0, \\ -\frac{\partial E_y}{\partial x} + \frac{\partial E_x}{\partial y} - \frac{\partial H_z}{\partial t} &= -\frac{2\phi mx}{r^3}, \\ \frac{\partial H_x}{\partial x} + \frac{\partial H_y}{\partial y} + \frac{\partial H_z}{\partial z} &= -\frac{2\phi mz}{r^3}. \end{aligned} \qquad (4)$$

The components of the electric current-and-density vector are found to satisfy, to the same degree of approximation, the following equations—

$$\begin{aligned} \Box\,\rho + \frac{12mxy}{r^5}\,\phi_1 &= 0, \\ \Box\,\sigma_x + \frac{12mxy}{r^5}\,\phi_1 &= 0, \\ \Box\,\sigma_y + \frac{12m}{r^5}(y^2 - z^2)\,\phi_1 &= 0, \\ \Box\,\sigma_z + \frac{24myz}{r^5}\,\phi_1 &= 0, \end{aligned} \qquad (5)$$

where $\square$ stands for

$$\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}+\frac{\partial^2}{\partial z^2}-\frac{\partial^2}{\partial t^2} \text{ and } \phi_1 \text{ for } \frac{\partial\phi}{\partial x}.$$

It can be verified that

$$\square\left(\frac{\partial\sigma_x}{\partial x}+\frac{\partial\sigma_y}{\partial y}+\frac{\partial\sigma_z}{\partial z}+\frac{\partial\rho}{\partial t}\right)=0 \qquad (6)$$

We have similarly obtained the ten gravitational field equations showing how the gravitational potentials $a_{ij}$ are modified on account of the electrostatic and electromagnetic potentials. The details and further deductions will be published elsewhere.

Benares Hindu University, V. V. NARLIKAR.
*October*, 19, 1948. RAMJI TIWARI.

* Einstein, A., "A Generalized Theory of Gravitation", *Rev. Mod. Phys.*, 1948, **20**, 35. A reference may also be made to the earlier papers in *Ann. Math.*, II (1945), **46**, 578 and (1946), **47**, 731.

## ON HOTELLING'S WEIGHING PROBLEM

IN the June issue of the *Annals of Mathematical Statistics*, Kempthorne approached the construction of the orthogonal matrix X required in Hotelling's weighing design through fractional replicates, the original discussion of which was given by Finney. While referring to weighing three objects, Kempthorne mentions about the three-fourth replicate of a $2^n$ factorial experiment without giving any details. It has been shown that the efficiency of such designs bears a constant ratio to that of the designs given by the completely orthogonalised matrices.

In a three-fourth fractional replicate, the treatment contrasts will divide themselves into groups of 4 contrasts each and in each such group only three contrasts will be independent. The contrasts in any group will be orthogonal to all the contrasts in the other groups but non-orthogonal to one another within the group itself. One contrast in the group of 4, preferably that due to the highest order interaction may be left out. The matrix X'X will take in this case the following form:

$$\begin{bmatrix} x & a & a & 0 & 0 & 0 & \cdots \\ a & x & a & 0 & 0 & 0 & \cdots \\ a & a & x & 0 & 0 & 0 & \cdots \\ 0 & 0 & 0 & x & a & a & \cdots \\ 0 & 0 & 0 & a & x & a & \cdots \\ 0 & 0 & 0 & a & a & x & \cdots \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdots \end{bmatrix}$$

where the order of the matrix $N=(3/4)\,2^n$ is of the form $3t$ $(t=2^{n-2})$ and $x=3\cdot 2^{n-2})$ $a=-\tfrac{1}{2}2^n+2^{n-2}=-2^{n-2}$. The value of the above determinant $=(x-a)^{2t}(x+2a)^t$ and that of the determinant suppressing the first row and the first column $=(x-a)^{2t-1}(x+a)(x+2a)^{t-1}$. Hence the variance factor $a^{ii}=(x+a)/[(x-a)(x-2a)]=\frac{1}{2^{n-1}}$, substituting for $x$ and $a$.

The variance of each estimate will therefore be $\sigma^2/2^{n-1}$, whereas the variance of the estimates given by an orthogonal matrix of the order $N=(3/4)\,2^n=3\cdot 2^{n-2}$ will be equal to $\sigma^2/3\cdot 2^{n-2}$. The ratio of the two variances $=2/3$. Therefore, the efficiency of a design given by a three-fourth replicate would always bear the constant ratio of 66·66 per cent of the efficiency of a design given by a completely orthogonal matrix. In general, when the fraction is of the type $(2\beta-1)/2\beta$ of $2^n$, $(\beta\; 1, 2, \cdots n)$, the variance of an estimate is $\sigma^2/2^{n-1}$, the same as above. When a completely orthogonalised matrix is available, the variance of an estimate will be $\sigma^2/[2^{n-\beta}(2\beta-1)]$. The ratio of the two variances $=2\beta^{-1}/(2\beta-1)$, which shows how the efficiency of the weighing design decreases with the increasing value of the fraction. When $\beta=1$, *i.e.*, in a half replicate, the efficiency is cent per cent. The value of the fraction is never less than ½.

Pusa, Bihar, K. S BANERJEE.
*November* 13, 1948.

1. Harold Hotelling, "Some improvements in weighing and other experimental techniques," *Annals of Math. Stat.*, 1944, **15**, 297-306. 2. K. Kishen, "On the design of experiments for weighing," *Ibid.*, 1945, **16**, 294-301. 3. A. M. Mood, "On Hotelling's weighing problem," *Ibid.*, 1946, **17**, 432-446. 4. R. L. Plackett and J. P. Burman, "The design of optimum multifactorial experiments," *Biometrika*, 1946, **33**, 305-325. 5. O Kempthorne, "The factorial approach to the weighing problem" *Annals of Math. Stat.*, 1948, **19**, 238-245. 6. D. J. Finney, "The fractional replication of factorial arrangements," *Annals of Eugenics*, 1945, **12**, 291-301. 7. K. S. Banerjee, "On the design of experiments for weighing and making other types of experiments" *Science and Culture*, 1948, **13**, 314. 8. — 'Weighing designs and balanced incomplete blocks," *Annals of Math. Stat*, 1948, **19**, 394-399.

## ON A CERTAIN BASIC THEOREM IN GEOMETRY

IN a recent issue of this journal,[1] I proposed a basic theorem in Geometry as a sort of mock challenge to see if any rigorous geometrical thinking comes out of it. The result was a heap of unnecessary discussions which clearly showed failure to perceive the point in my theorem. If one had recollected David Hilbert's Foundations of Geometry or recognised the need for a definition characterising the interior of an angle formed by two half-rays, the theorem would have been easily disposed of. David Hilbert does not give a definite construction for an interior point of an angle, though he mentions[2] that the half-rays together with their intersection divide the remaining points of the plane containing them into two regions, one of which may be characterised as the interior of the angle from the property that the segment joining any two points of it lies entirely within the region. I give below a construction for determining an interior point.

Let P be any point on a half-ray $h$ and Q any point on a half-ray $k$, proceeding from a point O. Draw parallels PR, QR to OQ, OP respectively. Then R is an interior point of the angle $(h, k)$.

More briefly, every vertex of a parallelogram is an interior point of the opposite angle.

The above statement may be treated as an axiom for the purpose of my theorem. It is, however, capable of rigorous proof with the help of Hilbert's axioms of order, congruences and parallels.

To proceed to my plane problem, let the given straight lines intersect at O, and R be any point not incident on either of these lines. If S, T be the feet of the perpendiculars on the given straight lines, it is required to show that the angle SRT is the supplement of the angle in which R lies, *viz.*, that which is given by my axiom as the angle POQ where P lies on O S and Q on O T and R P O Q is a parallelogram. Here O S, O T do not signify half-rays but whole straight lines.

The theorem immediately follows if the given straight lines cut at right angles. When the given lines do not cut at right angles, let $\alpha$ be the measure of the acute angle between them.

The triangles RPS, RQT are similar right-angled triangles, since the acute angles RPS, RQT, by the property of parallels, must each be equal to $\alpha$;

$$\text{further} \quad \sin\alpha = \frac{RS}{RP} = \frac{RT}{RQ} = \frac{RT}{OP},$$

as OP=RQ from the parallelogram RPOQ. (1)

Again, since S, T lie on the circle on OR as diameter, $ST = OR \sin S\hat{O}T = OR \sin\alpha$ (whether $S\hat{O}T = \alpha$ or $\pi - \alpha$) (2)

From (1) and (2), $\frac{RS}{RP} = \frac{RT}{OP} = \frac{ST}{OR}$ which proves that the angle SRT is equal to the angle RPO which is the supplement of the angle POQ.

The theorem is therefore proved.

Cor. R lies in the acute angle or the obtuse angle between the given lines according as

$$ST^2 \lessgtr SR^2 + RT^2.$$

In particular, if the given lines be $x \cos\alpha_i + y \sin\alpha_i = p_i$ $(i = 1, 2)$ and R $(0, 0)$, then S is $(p_1 \cos\alpha_1, p_1 \sin\alpha_1)$ and T is $(p_2 \cos\alpha_2, p_2 \sin\alpha_2)$ and the origin will be in the acute or obtuse angle between the lines according as

$$(p_1 \cos\alpha_1 - p_2 \cos\alpha_2)^2 + (p_1 \sin\alpha_1 - p_2 \sin\alpha_2)^2 \gtrless p_1^2 + p_2^2$$

$$i.e., \; p_1, p_2 \cos(\alpha_1, -\alpha_2) \lessgtr 0.$$

The corresponding three-dimensional result is an immediate deduction from the above if one considers the traces of the given planes on the plane through the given point perpendicular to them.

*N.B.*—No figure is necessary to follow the above proof. Everything follows logically from the axioms and known theorems. My axiom clarifies the location of an interior point of an angle and states in an idealised form a perceptual fact.

A. A. KRISHNASWAMI AYYANGAR.
Andhra University,
Waltair,
*December* 7, 1948.

---

1. *Curr. Sci.*, 1948, **17**, 233. 2. David Hilbert. (Translated by Townsend), *Foundations of Geometry*, 2nd Edition, 1910, 14.

## NUCLEIC ACID ANTAGONISM OF PENICILLIN BACTERIOSTASIS

IN a 'careful re-investigation' of our experiments[1] on the antagonistic effect of nucleic acid on the bacteriostatic action of penicillin, Ganapathi *et al.*,[2] report that they have failed to repeat our results and offer an explanation for the observations we have made. If the contention is that nucleic acid had no effect on the bactericidal action of penicillin as the title of their report would imply and as repeated in the text (para 4) we have nothing to state except to add that it is well known that organisms which have undergone bactericide by penicillin or any other drug cannot be revived and restored to life by any known process, whatsoever, since the organisms would have lost their lives under the influence of the drug. However, in bacterial cultures kept in the presence of bacteriostatic concentrations of penicillin whose action is reputed to be essentially bacteriostatic, under the conditions, instantaneous death of the organisms never result but only a temporary cessation of respiratory and reproductive processes resulting in inhibition of growth and multiplication. An agent which can sidetract, annihilate or by some means bring down the effective concentration of penicillin when added to the culture, will stimulate almost a sudden restoration of viability and consequently growth is imperative. Our experiments relate only to this latter condition and we repeat our claim. Under the influence of rather high concentrations of penicillin as for example two to sixteen units per ml. not only the organisms suffer death but also undergo lysis. A lack of appreciation of the bacteriostatic and bactericidal effects in relation to drug concentration has brought all the difference and in mode of action studies of drugs, one has very little use of dead organisms. There is no mention in the note about the actual value of the minimum bacteriostatic concentration of penicillin and remembering that the inoculum is comparatively small one can see that even 0·05 unit per ml. is above the bacteriostatic range, as otherwise, there is absolutely no reason why growth did not occur in Ganapathi, *et al.*'s cultures.

In Benedict, *et al.*'s paper[3] quoted by Ganapathi, *et al.* on page 94 is stated 'these data show the rapid increase in stability of penicillin as the hydrogen- ion concentration decreases (pH 2·0 to 6.0) with subsequent increase in decomposition as the concentration of the hydroxyl ions becomes greater, and this fact is illustrated on page 93 of the same paper. This means that penicillin ought to be stable in cultures which reach pH 5·2 to 5·5 at 37° C. But Ganapathi, *et al.* state that at this pH and when incubated at 37° C. small concentrations of penicillin are fairly easily destroyed. We would like to ask (*i*) if penicillin is not destroyed at pH 5·2 to 5·5 as the observations of Benedict, *et al.* claim is it not antagonism of penicillin action which added nucleic acid exerts with subsequent growth in our cultures and (*ii*) if penicillin is destroyed as Ganapathi *et al.*, claim, why they failed to see growth in the presence of nucleic acid, at least visual

turbidity in the tubes containing lower concentrations of penicillin particularly when in the presence of nucleic acid alone there is as much depth of turbidity due to growth as is indicated by four *plus* signs. There is thus a clear contradiction between the observation and explanation which Ganapathi, *et al.*, have described. Thirdly the statement in the last paragraph of the note Ganapathi *et al.* imply that penicillin cannot be destroyed at pH 7·0 under the conditions they describe. It is now well known that as the pH tilts to alkalinity penicillin gets progressively destroyed.

It is also well known that penicillin acts best on young actively growing cells. Since the optimum growth of pathogenic organisms happens to be 37° C., penicillin is more active at 37° C. than at lower temperatures on bacteria. In the case of insensitive bacteria like *Esch. coli* requiring high minimum inhibiting concenrtations of penicillin, even very high concentrations of nucleic acid 1/100 cannot reverse the inhibtion brought about by penicillin, while this is actually achieved by the magnesium salt of nucleic acid.[4] We have indeed found that the organisms which had become nonviable by contact with bacteriostatic concentration of penicillin were actually rendered viable by added nucleic acid[1] a fact which clearly indicates the lack of any correlation between pH effects and capacity of nucleic acid to antagonise penicillin bacteriostasis. It may thus be seen that under the conditions used, pH effects and temperature effects do not orientate the influence of nucleic acid on penicillin bacteriostasis and our conclusion that nucleic acid reverses the bacteriostatic effect of penicillin on *Staph. aureus* seems quite warranted. It is interesting to note in this connection that Pratt and Dufrenoy[5] have offered a very sound and convincing explanation of our observations.

Dept. of Biochemistry, Indian Institute of Science, Bangalore,
K. M. PANDALAI.
MARIAM GEORGE.
*October* 6, 1948.

1. Pandalai, K. M. and George, M., *Brit. Med. Jour.*, 1947, **2**, 210; *Curr. Sci.*, 1947, **16**, **312**. 2. Ganapathi, K., Sadasivan, V., Barucha, F. D., and Radhakrishnan, M. R., *Curr. Sci.*, 1948, **17**, 263. 3. Benedict, R. G., Schmidt, W. H., Coghill, R. D., and Oleson, A. P., *Jour. Bact.*, 1945, **49**, **85**. 4. George, M., and Pandalai, K. M., *Brit. Med. Jour.*, 1948, **1**, 1028. 5. Pratt, R., and Dufrenoy, J., *Bact. Revws.*, **1941**, **12**, 93.

---

WE have carefully considered the note of Pandalai and George and have to report that our original contention stands. In the note of Pandalai and George, it is claimed that "they have shown that nucleic acids possess the property of antagonising penicillin action" and they have "suggested that penicillin interferes with certain phases in the metabolism of the organisms where nucleic acids feature either as metabolites helping cell division or function as respiratory catalysts or both." If this sweeping assertion be true, then nucleic acids should antagonise the action of penicillin *in vitro* in a very significant way. We have shown that this is not the case. Our experiments have been misinterpreted by Pandalai and George. When the broth contains penicillin in concentrations ranging from 0·05 units to 16 units per ml. *along with* nucleic acid or its sodium salt in concentrations ranging from 1/10000 to 1/200, we could observe no reversal of bacteriostatic action against *Staphylococcus aureus*. When nucleic as the free acid is used, in the borderline concentration of 0·05 units per ml., there is an apparent slight reversal of penicillin bacteriostasis, which we have suggested to be due to the destruction of penicillin and consequent lowering of the concentration to an extent at which it is not bacteriostatic. Pandalai and George now question this destructive action of nucleic acid. We have experimental evidence to support our conclusion. To the broth was added in one case penicillin *plus* sodium salt of nucleic acid in the other penicillin *plus* free nucleic acid. These were incubated at 37° C. overnight and the penicillin concentration in the two sets of tubes estimated by the iodine titration method. In the broth containing sodium salt of nucleic acid about 90% of the added penicillin could be recovered, while in those containing free nucleic acid only 40 to 50% of the added penicillin could be recovered. Thus, when in the borderline concentration of 0·05 units per ml. about 50% of the penicillin is destroyed, the remaining quantity is not sufficient to show the full degree of bacteriostasis. Where higher concentrations of penicillin are used, even after the destruction of 50% of the added penicillin, there is still enough penicillin left over in the broth to show bacteriostasis. There is no contradiction in the result, as has been suggested by Pandalai and George. All the results reported by Pandalai and George are due to this destruction of penicillin by nucleic acid and no experimental evidence has been advanced to prove their elaborate theory.

Pandalai and George claim that cultures rendered nonviable by "prolonged contact with penicillin" are rendered viable by the addition of nucleic acid. According to their experiments, the cultures have been kept in contact with penicillin for 3 and 6 hours only. We have repeated the experiment and have found that under these conditions all the organisms are not rendered nonviable. In our experiments, one mm. loopful of a 24-hour old culture of *S. aureus* was inoculated into 5 ml. of standard broth containing different concentrations of penicillin. These were incubated for 3, 6 and 18 hrs. at 37° C and at the end of these periods, 0·1 c.c. of these cultures were transferred to 5 ml. of sterile broth and these tubes were incubated for 24 hours. Thus by reducing the concentration of penicillin, the viable organisms present are allowed to grow. We have found growth in all the tubes in which penicillin was used in concentrations of 0·1 to 0·3 units per ml. in the original tubes. Thus it is clear that even with 18 hours contact with penicillin, all the organisms do not become nonviable as claimed by Pandalai and George. So the organisms that are left over start multiplying when nucleic acid is added to the broth which destroys penicillin.

Thus Pandalai and George have not produced any proof to support their contention. They refer to the review of Pratt and Dufrenoy; these authors do not confirm the observations of Pandalai and George; they only comment on them. We primarily question the correctness of the results of Pandalai and George.

Haffkine Institute, Parel, Bombay, *November* 13, 1948.

K. Ganapathi.
V. Sadasivan.
F. D. Bharucha.
M. R. Radhakrishnan.

## SEX INHERITANCE IN *LUFFA ACUTANGULA*

As a result of single plant selection studies, some true breeding cultures for various characters have been established from the local material of *Luffa acutangula* and two of such selections which differed in their sex condition formed the basis of the present genetical studies, *viz.*, *Jhingli No. 1* which is monœcious and *Satputia No. 1*, hermaphrodite.

Crossing was attempted both ways, but it succeeded with *Satputia No. 1* as female only. Sixteen $F_1$ hybrids were raised, all of which proved to be monœcious (producing male and female flowers on the same individuals). Very rarely hermaphrodite flowers were also observed on the same individuals. Pollen formation and seed setting were found to be quite normal in these hybrids.

$F_2$ generation was raised from selfed seeds of four different $F_1$ hybrids. In all 266 hybrids were raised and studied and they could be distinctly classified into three different classes (Table I), as explained below:

(*a*) *Monœcious plants*: This class of hybrids showed the sexes in different flowers, male and female, on the same individuals. They exhibited variation in two directions, *viz.*, (1) in the stage at which the female elements appeared, as in some of them the female flowers appeared soon after the male ones, whereas in others at a very late stage, and (2) in the appearance of hermaphrodite flowers in addition to male and female ones. In some of them such flowers appeared in greater number than in others.

(*b*) *Female plants*: This class of hybrids produced female flowers only.

(*c*) *Hermaphrodite plants*: This class of hybrids produced hermaphrodite flowers only.

Table I

*Segregation in $F_2$ population for different sex forms in a varietal cross of* L. acutangula

| | Segregation in $F_2$ generation | | | Total No. of $F_2$ hybrids |
|---|---|---|---|---|
| | Monœcious | Female | Hermaphrodite | |
| Observed | 203 | 51 | 12 | 266 |
| Expected on 12 : 3 : 1 | 199·5 | 49·875 | 16·625 | 266 |

$X^2 = 1·372$ ; $p>0·50$

The $F_2$ segregation indicates that there are possibly two independent factor pairs, responsible for sex inheritance in this cross, designated as *AA BB*: The factor pair *AA* controls the expression of sex elements, both male and female, distributed in separate flowers on the same plant (monœcious condition). Where this factor for monoecious condition is lacking (in plants which are *aa*), the plant would be hermaphrodite, but this expression is influenced by the other factor *B* which controls the expression of female sex only and in its absence the plant again becomes hermaphrodite. But the factor *B* is ineffective in the presence of *A* which may be said to be epistatic to *B*. Sex in plants which are *aa* is then exclusively determined by *B*. Thus in the absence of *A* the hybrids with the constitution *aa BB* or *aa Bb* would be female plants and those with *Aa* or *AA* would be monœcious whether *B* is present or absent. In the absence of both *A* and *B*, the plant with the constitution *aa bb* will be hermaphrodite (the double recessive genotype). The constitution of the parents will thus be *aa bb* in the case of *Satputia No. 1* and *AA BB* in the case of *Jhingli No. 1*.

In short, sex inheritance in this cross is controlled by two independent factor pairs, one of which determines the expression of both sexes, whereas the other one controls female sex only, the first one being epistatic in action. In the absence of both, an individual becomes hermaphrodite.

Agric. Res. Institute, Botanical Section, Sabour, Bihar, *October* 7, 1948.

R. H. Richharia.

## PRODUCTION OF *P*-CYMENE FROM CARENE*

Carene is a raw material for the production of *p*-Cymene (*i*).[1,2,3,4] The work reported in this note is on the disproportionation of this hydrocarbon to (*i*) over $Fe_2O_3$-gypsum catalyst.

The catalyst is prepared as follows: 17·5 gm. of $FeSO_4 . 7 H_2O$ is dissolved in 500 c.c. water; added to the solution a few c.c. con. nitric acid and gradually heated. To the fully oxidised solution added ammonium chloride and then dilute ammonia carefully with stirring, until the precipitate is permanent. The precipitate is washed by decantation several times with water. Mixed in 300 gm. of well-washed gypsum pieces, 8-10 mesh size. It is then dried on a water-bath with constant stirring, and finally ignited to the oxide stage in a fire-clay crucible.

Carene (b.p. 163-68° C./745 mm. $d_{15}^{15}$: 0·8468, $n_D^{20}$: 1·4716) fractionally distilled from Indian turpentine (*P. longifolia*), is passed over the catalyst bed, 60 cm. long, occupying a total space of 234·0 c c.; time of contact is 3 hours for 100 c.c. carene.

The pyrogenic unit is described in a previous communication.[4]

Identification of (*i*) is by oxidation by chromic acid to terephthalic acid (dimethyl ester, m.p. 140° C.).

Table I gives the analysis of the major fraction containing (*i*) after one fractionation; Table II gives the result of the fractional

distillation of the pyrolysates. Young's 8-pear pyrex column is used in all cases.

TABLE I
*Analysis of the fraction boiling 173-78° C./745 mm.*

| | Temperature of pyrolysis ±15° C. | % Yield on the wt. of carene fed | Iodine value (Wijis method) | $d_{15}^{15}$ | $n_D^{20}$ |
|---|---|---|---|---|---|
| 1 | 300° C. | 28·0 | 84·0 | 0·8572 | 1·4820 |
| 2 | 350° C. | 23·6 | 77·0 | 0·8627 | 1·4875 |
| 3 | 400° C. | 20·5 | 79·7 | 0·8631 | 1·4860 |
| 4 | 500° C. | 14·9 | 71·3 | 0·8805 | 1·5013 |

TABLE II
*Analysis of the pyrolysates.*

| | B.P. C. 745 mm. | % yield on the wt. of carene — Pyrolysis temperature ±15° C. 300° C. | 350° C. | 400° C. | 500° C. |
|---|---|---|---|---|---|
| 1 | Gases | 15·0 | 11·8 | 8·9 | 33·0 |
| 2 | -75° | 0·5 | 0·9 | 2·2 | 4·1 |
| 3 | 75–100° | 2·0 | 0·9 | 1·3 | 2·0 |
| 4 | 100–120° | 1·0 | 0·9 | 0·4 | 3·7 |
| 5 | 120–143° | 1·5 | 1·8 | 4·0 | 7·5 |
| 6 | 143–163° | 9·0 | 8·1 | 8·4 | 9·1 |
| 7 | 163–173° | 30·0 | 38·1 | 37·5 | 11·5 |
| 8 | 173–178° | 28·0 | 23·6 | 20·5 | 14·9 |
| 9 | Above 178° | 12·0 | 10·9 | 10·3 | 12·4 |
| 10 | Losses, etc. | 1·0 | 3·0 | 6·5 | 1·8 |

At 400° C. and 500° C. $Fe_2O_3$-gypsum is a more efficient catalyst than Pt-gypsum.[4] It yields purer crude (*i*) than that obtained with $V_2O_5$[4] or Pt-gypsum at 300°-500° C.

Thus the order of activity of the catalysts: partially-dehydrated gypsum,[4] $Fe_2O_3$-gypsum, Pt-gypsum and $V_2O_5$: with respect to the purity of crude (*i*) produced is:

Partially-dehydrated gypsum > $Fe_2O_3$-gypsum > Pt-gypsum > $V_2O_5$.

Impregnation of gypsum with $Fe_2O_3$ or Pt does not increase its dehydrogenation power.

At 500° C., $Fe_2O_3$-gypsum catalyst exercises an aggressive effect on carene and yields over two and a half times the quantity of gaseous products than that obtained with partially-dehydrated gypsum.[4]

Lower fractions boiling from 120° C. to 173° C. give positive tests for (*i*) as evidenced by the formation of terephthalic acid when the samples are oxidised by chromic acid. Refractionation improved the yield of crude (*i*) by 30%.

This publication is delayed due to the political changes at Lahore.

Technical Chem. Lab., Forman Christian College, Lahore,
*October* 8, 1948.

JAMES VERGHESE.
H. K. SONDHI.
BHARAT BHUSHAN.
M. L. JOSHI.

* The word 'carene' is purposely used. There is evidence that natural $\Delta^3$ - carene is not quite homogeneous.[5,6,7]

1. Kungl, Armeforvaltiningens Artilleri department (K.I.E. Skarblom and A. V. B. Linder) *Swed. Pat.*, 1938, **92**, 484. 2. Verghese, Bhushan, Gulati and Joshi, *J. Indian Chem. Soc.*, (Ind. and News Ed). **1944, 7,** No. 2, 93. 3. Guha, Roy and Paul, *J. Indian Inst. Sci.*, 1944, **26A,** 1. 4. Sondhi, Bhushan, Gulati and Joshi, *J. Indian Chem. Soc.*. (Ind. and News), **1947, 10.** Nos. 1 and 2, 17. 5. Goodway and West, *J. Chem. Soc.* 1938, 2028. 6. Guha and Roy, *J. Indian. Inst. Sci.*, **23A,** Part XIII, 204. 7. Rudakov and Artamanov, *J. Gen. Chem. Russ.*, 1945, **15,** 75.

## ON SOME PHYSIOLOGICAL PROPERTIES OF EXTRACTS OF WHEAT GRAINS

THE conditions generally necessary for successful seed germination are sufficient moisture as well as aeration and an appropriate temperature. According to Nelson[1] some kinds of seeds, *e.g.*, carrot and parsley, tolerate and indeed benefit from presoaking for 24 hours or even more, whereas a mass of soaking beet seeds can poison themselves in quite a short time unless the water is frequently changed. Evidently release of a poisonous substance from the seed is indicated. Duym, *et al.*[2] conclude, however, that the inhibiting effect of the extract from the seed balls of sugarbeet on the germination of Avena seeds is mainly due to the osmotic pressure of its salt content. Bonner, *et al.*[3] have found that the water extract of peas contains a leaf growth hormone. It now appears to be definitely established that seeds of maize, barley, rye and wheat contain free auxin (*cf.* Hatcher,[4] Avery, *et al.*,[5] Haagen-Smit, *et al.*[6]), which diffuses out into water medium.

The presence of salts or hormones in the water extract of seeds has interest from another point of view. It has been reported by Henkel, *et al.*[7] and also by Chinoy[8] from this laboratory that drought resistance is induced by alternately soaking wheat grains in water and drying prior to sowing. In view of the findings referred to above it is quite likely that some substances diffuse out from the seeds during soaking in water. With a view to investigating the causes underlying this effect of the water-soaking treatment we considered it worth while in the first instance to examine the properties of water extracts of wheat grains. Some of the observations made during the course of this study appear interesting and an account of the same is presented here.

Preliminary observations indicated that whereas the water extract of seeds of *T. Vavilovi* retarded the growth of the main root of germinating seeds of maize and wheat (sown in sand and moistened with extract), that from seeds of another variety, *viz.*, N. P. 165 had no such effect. A study of a number of varieties was, therefore, undertaken. As a test object the main roots of 15 germinating maize—var. Pusa yellow—seedlings (about 48 hours from sowing at room temperature when the main root was about 1·5 cm. long) were used. The seedlings were kept in petri-dishes with roots immersed in about 20 c.c. of distilled water or the extract and the lengths of the main roots

TABLE I

| Test period in hrs. | Variety | Root growth in cm. | | | |
|---|---|---|---|---|---|
| | | Distilled water | Extract | Ashed extract | |
| 15 | Khapli | 3·17±0·15 | 1·06±0·04 | 3·0 ±0·15 | |
| ,, | N.P. 165 | ,, | 2·76±0·14 | 3·25±0·22 | |
| | | Distilled water | Extract (original) | Ether Extract | Residue insoluble in ether |
| 18 | Khapli | 3·80±0·16 | 2·44±0·14 | 2·91±0·29 | 2·51±0·16 |
| | | Distilled water | Extract | Extract dried at 80° C. | |
| 18 | Khapli | 3·80±0·38 | 2·44±0·14 | 2·40±0·11 | |

were measured again after about 15 hours. The difference in the growth made during the test period in distilled water and in the extract indicated the presence as well as strength of the inhibiting substance or substances. Except during actual measurement of length, the seedlings were always kept in the dark at room temperature. Temperature during the test period was not controlled and the test period also varied from 15 to 18 hours according to convenience. Since most observations are comparative these defects in the technique may not seriously affect the validity of the results.

The extract was obtained by soaking 200 or 10 gm. of air dry seeds in 30 c.c. of freshly boiled (and cooled) distilled water for 3 hours at room temperature. Before soaking, the seeds were washed 12 times with tap water, 8 times with distilled water, for 2 minutes with rectified spirit and finally 6 times with freshly boiled and cooled distilled water.

In Table II, column 5, are presented the results of tests with nine varieties of wheat from which it appears that extracts of *T. Vavilovi* and Khapli alone contained the inhibiting substance. The depressing effect of auxin on root growth is well known. Experiments were, therefore, undertaken to see what type of substance in the extract inhibited root growth. Seeds of Khapli alone were used for detailed study as it is difficult to raise a good crop of *T. Vavilovi* under Delhi conditions.

It was found on evaporating the extract to dryness on the water-bath that a brown sticky syrup with a sweet smell was left as a residue indicating caramelisation of sugar. The presence of sugar in the pea extract has been reported by Bonner, *et al.*[3] Root growth was, however, not retarded in 1% sucrose solution during the usual period.

That the inhibiting effect of the extract was not due to its salt content was determined by ashing the extract and testing the aqueous solution of the ash (*cf.* Table I). Apparently some organic substance other than sugar inhibited root growth, The data in Table I indicate that it was possible to extract the substance with ether, although not completely, from the dry extract. Data in Table I also indicate that the substance was thermostable (up to about 80° C.).

Split coleoptiles gave an inward curvature when immersed in the extract as they usually do under the influence of auxin. The roots grown in the extract also appeared thicker (*cf.* Thimann[9]). It is, therefore, presumed that the growth-inhibiting substance in the extract is hormonal in nature and is probably free auxin.

The difference between the varieties still remained to be accounted for. According to

TABLE II

| Test period in hours | Variety | Days from sowing to flowering | Growth in cm. | | |
|---|---|---|---|---|---|
| | | | Distilled water | Ordinary seed | Punctured seed |
| 18 | *T. Vulg.* N.P. 165 | 90 | 3·38±0·20 | 3·31±0·17 | 0·97±0·07 |
| 14 | *T. Vulg.* C 13 | 90–100 | 2·77±0·22 | 2·16±0·17 | 1·45±0·05 |
| ,, | *T. Pyramidale* | 110–120 | 2·77±0·22 | 2·39±0·20 | 0·99±0·12 |
| 15 | *T. Dicoco.* Mindum | 120–130 | 2·37±0·14 | 2·15±0·24 | 0·84±0·08 |
| 14 | *T. Durum* Kubanka | 130–140 | 1·95±0·24 | 2·09±0·09 | 0·50±0·06 |
| 17 | *T. persicum* Persian Black | 140–150 | 2·28±0·23 | 1·76±0·17 | 0·63±0·09 |
| 14 | *T. Polonicum* | 150–160 | 1·95±0·24 | 1·83±0·16 | 0·63±0·05 |
| 15 | *T. Dicoco.* Khapli | 100–110 | 2·77±0·15 | 1·22±0·07 | .. |
| 16 | *T. Vavilovi* | 160–170 | 3·22±0·14 | 2·03±0·13 | .. |

Hatcher,[4] in the rye grain the major proportion of auxin is concentrated in the aleurone layer. Seeds of the varieties whose extracts did not inhibit root growth were, therefore, soaked in water for about half an hour just to soften them and were then pricked at four places near the embryo with a pin with a view to puncturing the aleurone layer and testa. Extracts from such seeds were found to contain the inhibiting substance as seen from data in Table II, column 6.

It is evident from the data above that the inhibiting substance does not diffuse through the aleurone layer or testa (whereas salts and sugar do) when seeds of these varieties are extracted with water at room temperature —about 95° F. That the inhibiting effect was not due to salts was ascertained by testing the ashed extract.

It was possible to extract this substance by treating seeds of NP 165 with water at a temperature of about 80°C. on a water-bath for about half an hour. Evidently the aleurone layer and the testa became more permeable at this temperature. Conversely when seeds of Khapli were extracted with water at a lower temperature—about 50°F.—they yielded a much smaller quantity of the inhibiting substance.

In conclusion, the differential effect of water-soaking treatment at room temperature on the release of a hormone-like substance—presumbly auxin—from grains of different wheats, as estimated by the 'root' test, is emphasized. It is possible that the more delicate 'Avena' test —which could not be carried out for want of equipment—might detect the presence of the hormone in extracts of those seeds which gave a negative result with the 'root' test. It is, however, felt that the quantitative difference in the yield of the substance between varieties would still persist. How far this differential effect would influence the subsequent performance of the varieties under different environments would appear to be worth consideration.

Our thanks are due to Dr. B. P. Pal, Head of the Division of Botany, for kindly interest and encouragement.

Division of Botany, Indian Agri. Res. Institute, New Delhi,
November 1, 1948.

R. D. ASANA.
V. S. MANI.

1. Nelson, A., *Pinciples Agri. Bot.*, London, 1946. 2. Duym, C. P. A., *et al.*, *Proc. Kon. Ned. Akad V Wetensch. Ams'erdam*, 1947, **50**, 527–35. 3. Bonner, D. M., *et al.*, *Bot. Gaz.*, 1940, **101**, 128–43 4. Hatcher, E. S. J., *Ann. Bot. N. S.*, 1945, **9**, 235–66. 5. Avery, G. S., *et al.*, *Am. J Bot.*, 1942, **29**, 612–16. 6. Haagen-Smit, A. J., *et al.*, *Ibid.*, 1942, **29**, 500–6. 7. Henkel, *et al.*, Quoted by Whyte in "Crop Production and Environment," London, 1946. 8. Chinoy, J. J., *Ind. Farm*. 1947, **8**, 72–74. 9. Thimann, K. V., *Am. J. Bot.*, 1937, **24**, 407–12.

## THE SPECTRUM OF IODINE VII

ABOUT a decade ago, L. and E. Bloch and Felici[1] published a long list of lines due to highly excited Iodine in the region λ 200 to λ 1,000. They divided their data however, into seven groups denominated 2−, 2, 2+, 3−, 3, 3+ and 4, but not into I, II, III, IV groups familiar in spectroscopic notation. From group 4, they picked up two lines ν 515060 and ν 525925 and identified them as due to I VIII. Starting with the clue that their data contains lines of I V, VI and VII too, the writer made an attempt to pick up from the same, the doublets of I VII by way of partly clearing up the data for the solution of I III and I IV, which are in progress in this laboratory.

Table I, which shows the application of the so-called Irregular Doublet Law, helped in the identification.

TABLE I

*Corresponding lines in Ag I-like spectra.*

| Spectrum | $5s^2S_{\frac{1}{2}} - 5p^2P_{\frac{1}{2}}$ | $5s^2S_{\frac{1}{2}} - 5p^2P_{1\frac{1}{2}}$ | $5p^2P_{\frac{1}{2}} - 5d^2D_{1\frac{1}{2}}$ |
|---|---|---|---|
| In III | 57185 | 61527 | 71273 |
| Sn IV | 69559 | 76077 | 95738 |
| Sb V | 81566 | 90554 | 120341 |
| Te VI | 93336 | 105151 | 144745 |
| I VII | 104960 | 119957 | 169059 |

of three lines and Hartley's Law, to fix up a fourth *i.e.* ν 154055 .

TABLE II

*Doublets of I. VII.*

| 5p | $2P_{\frac{1}{2}}$ | $2P_{1\frac{1}{2}}$ |
|---|---|---|
| $5s\ ^2S_{\frac{1}{2}}$ | 104960 (5) | 119957 (6) |
| $5d\ ^2D_{1\frac{1}{2}}$ | 169059 (4) | 154055 (20) |
| $^2D_{2\frac{1}{2}}$ | | 156294 (6) |

Further support to the scheme presented in Table II is afforded by the fact that the two intervals $5p$ ($^2P_{\frac{1}{2}}$—$^2P_{1\frac{1}{2}}$) and $5d$ ($^2D_{1\frac{1}{2}}$−$^2D_{2\frac{1}{2}}$) obey the law of screening constants. The line ν154055 (20) is of abnormal intensity but is found to represent also the combination, $5p^3P_2 - 5d^3D_3$ in I VI.

Presidency College, Madras;
November 3, 1948.

I. FERNANDO.

1. *Jour. de Phy. et le Rad.*, 1937, **8**, No. 9.

## A NOTE ON CARP OVA AND THEIR HATCHING

IN the river Halda of Chittagong, East Bengal, millions of ova of *Catla catla* (Hamilton), *Labeo rohita* (Hamilton) and *Cirrhina mrigala* (Hamilton) are collected in various stages of development and are hatched in specially prepared hatchery pits excavated

on the banks of the river.[1] The larvæ thus obtained are nursed till these are transformed into fry and attained the age of 4-5 days. By this time the fry are sufficiently grown up to stand transportation and are exported in earthen vessels to long distances for cultural purposes. A large number of developing ova were collected during the spawning seasons of 1946, 1947 and 1948 and weighed with a fairly sensitive balance to ascertain the correlation between their weight and number. Several observations were made and it was found that on an average 7,520 ova weighed one lb. In the year 1947 as much as 100 lbs. and this year 113 lbs. of ova were collected by us. The collection was a mixture of eggs of the three major carps named above but with those of *Mrigala* dominating.

Incidentally it may be pointed out that Khan[2] found 1,85,854; 65,450 and 35,378 ova weighing one lb. in each case in gravid females of *L. rohita*, *C. mrigala* and *C. catla* respectively. The writer counted 13,920 ova of different sizes in the ovaries, 3·2 oz. in weight, of *Barbus* (*Lissochilus*) *hexagonolepis* McClelland, in the breeding season. Similarly in ovaries, weighing 2 oz., of the same species of *Barbus*, 8,724 ova were found. The ova while inside the ovary are closely surrounded by membranes but as soon as shed and fertilized, swell enormously by absorption of water. Thus egg[3,4,5] of *C. catla* increases from 2·0-2·2 mm. to 5·3-6·5 mm. in diameter, egg of *L. rohita* from 1·5 mm. to 4·5-6·0 mm. and of *C. mrigala* from 1·5 mm. to 3·0-4·0 mm., while the increase in diameter in *B.* (*Lissochilus*) *hexagonolepis* is not very appreciable. The increase in weight of the egg is, however, many times more than in diameter.

In the nursery pits larvæ of the major carps hatch out within 24 hours of fertilization of ova. These were collected a day after hatching and weighed. About 3,53,280 of them weighed one lb. On this basis, out of 94 lbs. of fertilized ova, only 2 lbs. (at that stage) of larvæ can be obtained, if the hatching percentage be cent per cent. In the departmental hatchery temporarily set up at the river Halda, out of 113 lbs. of ova (8,49,760 in number approximately,) 6,10,080 fry were obtained on the 4th day after hatching. The weight of these fry on the day was 4 lbs., *i.e.*, approximately 1,52,520 of them were equal to one lb. The same number of specimens, *i.e.*, 6,10,080 which weighed 4 lbs. on the 4th day, weighed only 1·8 lbs. a day after hatching. The hatching percentage in this case, on the basis of calculation on the 4th day, comes to about 72%.

"The local hatchers are under the impression that they get 75 per cent. and even 100 per cent. of the eggs hatched but as they get generally something like 1 oz. of larval fish to 75 oz. of eggs, their contention seems to be very doubtful," observed Mazumdar.[6] According to the information collected by the writer the spawn catchers usually get from 25 to 50% hatching by following their usual methods. They do not have very clear idea about the weight, number, etc., because they seldom count them and weigh them only after 4-5 days when actual sale begins.

Directorate of Fisheries, NAZIR AHMAD.
East Bengal, Comilla,
*November* 5, 1948.

1. Ahmad, Nazir (in press). 2. Khan, Hamid, *The Punjab Fisheries Manual*, 1945, 6. 3. Ahmad, Nazir, *Proc. Nat. Inst. Sci. India*, 1948, 23. 4. Khan, Hamid, *Bomb. Nat. Hist. Soc.*, 1934, 157-59. 5. Mookerjee, H. K., *Science and Culture*, 1944-45, 401. 6. Majumdar, C. H., *Ibid.*, 1940, 735.

## PHOTO-ELECTRIC ESTIMATION OF SILICON IN STEELS

IN the course of our investigations on colorimetry and metallurgical analysis we had occasion to devote considerable attention to the estimation of silicon in steel by employing the molybdenum blue method. In the present note it is proposed to summarise the broad features of our observations which may be stated as follows:

(1) It would be highly advantageous to employ 35 m.l. of an oxidising solvent mixture, prepared by dissolving 6 to 7 grams of ammonium persulphate in 100 m.l. of 10 per cent. sulphuric acid, instead of 70 m.l. of 5 per cent. acid alone as recommended by Vaughan[1] for the initial treatment of the steel samples. This results in a saving of at least ten minutes in the time taken for dissolving the sample; further, the addition of $KMnO_4$ can be avoided.

(2) There seems to be no need to drive off the residual sulphurous acid. On the other hand, it is found that in the presence of adequate excess of this reagent the results obtained are very satisfactory and easily reproducible.

(3) Attempts to replace sulphurous acid by hydrogen peroxide in Vaughan's procedure (*loc. cit.*) showed that greater care is needed in this case since even a slight excess of hydrogen peroxide lowers the drum differences considerably. A reducing medium is distinctly more favourable than an oxidising one.

(4) Increasing the concentration of hydrochloric acid in the stannous chloride reagent has the effect of increasing its stability without exerting any adverse influence on the intensity or stability of the final blue colour.

(5) The concentration of sulphuric acid added at the second stage can be varied conveniently between 20 to 40 per cent.

(6) Waiting for fifteen minutes after the addition of stannous chloride has been found to be unnecessary in tropics where the prevailing laboratory temperature is considerably high. A saving of ten minutes could easily be effected at this stage. It has also been noted that the estimation must be completed within thirty minutes after the addition of stannous chloride, failing which the blue colour gradually begins to fade.

(7) After the initial treatment, the steel solutions can be preserved for a considerable number of days without any deterioration,

This comes in handy to check the concentration-drum difference graphs periodically by employing the stock solutions of standard steels instead of starting right from the beginning in each case.

Based on the observations recorded in this note a modified procedure has been evolved for the estimation of silicon in steel by adopting which, it has been possible to effect a saving of about twenty-five minutes for a single estimation. This has been applied to a large number of steels covering a wide range of variety and is being extended to some more. Full details giving further particulars will shortly be published elsewhere.

The authors' thanks are due to the management of the Tata Iron and Steel Co., Ltd., for permitting the publication of this note and to Dr. J. C. Ghosh and Mr. N. B. Sen, our present and former Chief Chemists, for their keen interest in the work.

G. V. L. N. MURTY.
N. C. SEN.

Res. and Control Labs.,
The Tata Iron & Steel Co. Ltd.,
Jamshedpur,
*November* 9, 1948.

1. Vaughan, E. J., *The Institute of Chemistry Lecture on "Further Advances in the Use of the Spekker Photo-Electric Absorptiometer in Metallurgical Analysis,"* 1942, pp. 6, 7 and 8.

## ASSIMILATION OF PHOSPHORUS DURING THE DECOMPOSITION OF PLANT MATERIALS

A SMALL abstract on the subject was published by the writer in the *Proceedings of the Indian Science Congress*, 1936. Since then Sing Chen Chang[1] has studied the problem in some detail but he has not been able to arrive at any definite carbohydrate and phosphorus relationship giving "Phosphorus Factor" as compared to the "Nitrogen Factor". This is perhaps due to the difficulty in arriving at the figure for the microbial phosphorus synthesized from mineral phosphorus for want of suitable method to distinguish it from the organic phosphorus initially present in the plant tissue. Secondly plant tissues contain mineral phosphorus in varying amounts in addition to the organic phosphorus and since the phosphorus requirements of organisms are much smaller compared to nitrogen, it is possible that even the small amounts of mineral phosphorus that may be originally present may be sufficient to meet the requirements of the organisms.

The following results, while similar to those obtained by Sing Chen Chang, also serve to bring out the existence of a "Phosphorus Factor" governing the relationship of phosphorus and carbohydrates during the decomposition of plant materials.

Plant materials were docomposed in bottles which were incubated at 30° C. Total phosphorus was determined at stated intervals by ashing the material with magnesium nitrate and bringing it into solution according to A.O.A.C. method. Inorganic phosphorus was separated by extraction with 1 per cent. HCl-Alchohol mixture. The colorimetric method of Fiske and Subbarow[2] was used for the determination of phosphorus in the samples.

The data in Table I A indicate the synthesis of organic phosphorus during decomposition of wheat straw upto 28 days; with the increase in the period of decomposition organic phosphorus mineralizes as judged from the last column in Table I A.

TABLE I

*Transformation of Phosphorus during the Decomposition of Wheat Straw and HCl-extracted wheat straw.*

| Days | % Loss of dry matter | % Total P | % Mineral P | % Organic P | Organic P % of Total P |
|---|---|---|---|---|---|
| A. (Wheat straw + N at the rate of 1% as ammonium sulphate) | | | | | |
| 0 | 0·0 | 0·250 | 0·130 | 0·120 | 48·0 |
| 14 | 25·0 | 0·333 | 0·163 | 0·170 | 51·1 |
| 28 | 40·8 | 0·417 | 0·167 | 0·250 | 59·9 |
| 56 | 50·5 | 0·501 | 0·243 | 0·258 | 51·4 |
| B. (HCl-extracted wheat straw + N at 1% as ammonium sulphate) | | | | | |
| 0 | 0 | 0·128 | .. | 0·128 | 100·0 |
| 14 | 5·1 | 0·129 | .. | 0·130 | 100·0 |
| 28 | 10·9 | 0·144 | 0·020 | 0·124 | 86·1 |
| 56 | 25·2 | 0·172 | 0·038 | 0·134 | 78·4 |

Since HCl-Alchohol mixture as indicated by Collison[3] removes inorganic phosphorus, the results in Table I B represent changes in decomposition when the starting material contained only organically combined phosphorus. The results would suggest that mineralization of phosphorus is essential before any decomposition is possible and that organic phosphorus does not appear to be readily available.

Since the foregoing results do not clearly indicate the amount of mineral phosphorus immobilized during decomposition, cellulose in the form of filter-paper was decomposed as scheduled below; use of filter-paper eliminates the complications arising out of the use of plant tissues containing both organic and inorganic phosphorus.

TABLE II

*Assimilation of mineral phosphorus during the decomposition of filter-paper*

10 gm. of filter-paper was decomposed for 6 weeks in the presence of $KH_2PO_4$, 1% N as sulphate of ammonia and traces of minerals 5 c.c. of inoculum from a garden soil was added to each bottle.

| Treatment | Cellulose decomposed | Inorganic P recovered | Inorganic P used up | Assimilation of P per 100 gm. Cellulose decomposed |
|---|---|---|---|---|
| 2 mgm. P | 1·05 gm. | nil | 2·00 mgm. | 0·1905 gm |
| 4 ,, ,, | 1·63 ,, | 0·70 mgm. | 3·30 ,, | 0·2024 ,, |
| 6 ,, ,, | 2·05 ,, | 2·08 ,, | 3·92 ,, | 0·1912 |

Figures in the last column of Table II suggest that "Phosphorus Factor" may be of the order of one-fifth that of the "Nitrogen Factor" (Richards and Norman)[1] assuming nitrogen factor to be unity for most plant materials. This figure agrees with that of Jenkins[5] who has observed in his studies on the biological oxidation of carbohydrate solutions that the proportion of phosphorus for efficient utilization of nitrogen lay between 0·12 and 0·31 parts per part of nitrogen. In other words, on an average, the phosphorus requirements of microflora are nearly one-fifth that of nitrogen. From the figures recorded by Sing Chen Chang on cellulose decomposed and the amount of inorganic phosphorus assimilated in 121 days at different levels of mineral phosphorus, the average phosphorus requirement of organisms for bringing about the decomposition of 100 gm. of cellulose works out to 0·26 gm.

It is thus reasonable to suppose that since the phosphorus requirements are nearly a fifth of their nitrogen requirements, the amounts of mineral phosphorus initially present in plant residues are thus quite enough for a satisfactory rot and that phosphorus therefore does not become a limiting factor for decomposition.

Further datailed experiments are in progress on this important problem.

Chemistry Section, J. G. SHRIKHANDE.
Agricultural College.
Kanpur,
*November* 9, 1948.

1. *Soil Sci.*, 1939, **48,** 85; 1940. **49,** 197. 2. *J. Biol. Chem.*, 1925, **66,** 375. 3. *Ibid.*, 1912, **12,** 65. 4. *Biochem. J.*, 1931, **25,** 1769. 5. *Ibid.*, 1935, **29,** 116.

## A NOTE ON "THERMOCHOR"

AFTER Sugden's *Parachor* and Friends's *Rheochor* comes another property 'Thermochor' (Carvalho[1]) which may prove to be a useful tool in physico-chemical research although it is too early to judge its potentialities. The property is associated with molecular volume $V_m$ of the substance at the boiling point and is defined by

$$\text{Thermochor} = [T] = [M/D]^{5/6}\, T_b^{1/4} = [V_m]^{5/6}\, T_b^{1/4}$$

where $T_b$ denotes the boiling point of the liquid on the absolute scale at normal pressure. It is proposed to examine the above relationship in various types of compounds where $V_m$ is either known (Kopp,[2] Lossen[3]) or can be calculated from temperature-density formula possessing sufficient degree of accuracy.[4] The following table contains the values of [T] for $-CH_2$ group in various types of compounds:—

TABLE I

| Compounds: Nature | Compounds: Number examined | Min. and Max. limits in [T] | Average [T] |
|---|---|---|---|
| 1 Hydrocarbons (aliphatic and satd.) | 9 | 39·4–42·7 | 41·3 |
| 2 Hydrocarbons (aliphatic and satd.) | 6 | 40·1–41·8 | 41·2 |
| 3 Hydrocarbons (aromatic) | 5 | 38·9–42·1 | 41·0 |
| 4 Cycloparaffins* .. | 5 | 34·6–39·0 | 34·9 |
| 5 Alcohols .. | 8 | 35·8–40·7 | 39·7 |
| 6 Fatty acids .. | 8 | 39·5–44·5 | 41·2 |
| 7 Esters (formates) .. | 8 | 38·4–42·1 | 40·9 |
| 8 ,, (acetates) .. | 8 | 40·3–42·8 | 41·4 |
| 9 Alkyl chlorides .. | 5 | 38·7–42·3 | 39·8 |
| 10 ,, bromides .. | 6 | 40·0–41·5 | 40·9 |
| 11 ,, iodides .. | 8 | 39·8–43·5 | 41·5 |
| 12 Ethers .. | 7 | 39·2–43·0 | 41·3 |
| 13 Nitriles .. | 5 | 37·5–41·6 | 39·8 |
| 14 Thio-Compounds* .. | 5 | 37·9–39·1 | 38·6 |
| 15 Amino Compounds* | 3 | 35·3–38·5 | 37·3 |
| 16 Aldehydes* .. | 4 | 36·1–37·2 | 36·7 |

From Table I it appears that the value of [T] is comparatively lower in compounds marked with an asterisk specially cycloparaffins. Further, by the usual method as adopted in the case of Parachor, the value of [T] for $H_2$ has been found to be 19·5 ($C_nH_{2n+2} - nCH_2$) from paraffins. From this result the atomic thermochors for various elements have been calculated and are given in Table II.

TABLE II

| Elements: | H | C | F | Cl | Br | I | S | N (amines) | O (ethers) | $O_2$ (Esters) | P | Si | As | Sn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [T]: | 9·8 | 21·8 | 16 | 48 | 61 | 84 | 62 | 22 | 20 | 43 | 46 | 41 | 55 | 49 |

It has also been observed that just like Parachor the values of [T] for isomeric substances of similar constitution are almost the same as may be seen from the following two examples:

| Isomeric compounds | [T] |
|---|---|
| 1 Butyl formate .. | 251·0 |
| 2 Propyl acetate .. | 251·3 |
| 3 Ethyl propionate .. | 250·0 |
| 4 Methyl butyrate .. | 249·0 |

| Isomeric compounds | [T] |
|---|---|
| 1 Amyl form te .. | 292·6 |
| 2 Butyl acetate .. | 292·5 |
| 3 Propyl propionate .. | 290·5 |
| 4 Ethyl butyrate .. | 290·5 |

Other compounds containing different types of linkages are being examined from this point of view and a detailed paper will appear elsewhere.

We are obliged to Mr. M. R. Nayar for helpful suggestions.

Chemical Laboratories, The University, Lucknow, November 21, 1948.
RAM GOPAL.
T. N. SRIVASTAVA.

1. Carvalho, *Nature*, 1947, **160**, 370. 2. Kopp, *Annalen*., 1855, **96**, 153, 303. 3. Lossen, *ibid*., 1889, 254, 42 and others. 4. *International Critical Tables*, 1928, **3**, 27.

## ON THE BIONOMICS OF THE FOWL TICK, *ARGAS PERSICUS*

LITTLE work has been done in India on the bionomics and life-history of the fowl tick, *Argas persicus* and there is a good bit of variation in the results obtained by different workers abroad [Sories (1922),[1] Newman (1924),[2] Salisbury (1938),[3] Rovida (1940)[4]] regarding the period of hatching of eggs and the survival of the larvæ in the absence of a host.

All observations both on the hatching of eggs and the survival of larvæ were made by me at room temperature, mainly during the months of July, August, September and October when the average temperature ranged from 82° to 97°F and the average percentage of humidity ranged from 73 to 83.

It has been generally observed that reproduction in this tick depends directly on the ingestion of food. I have never come across pairing or oviposition when the ticks were kept starved in tubes. Within a couple of days after these ticks, under varying periods of starvation, were allowed to feed on a fowl, the female started laying eggs in batches of 20-60.

The eggs are round and a little smaller in size than a pin-head. They are laid in irregularly shaped clusters and when fresh are of a bright fawn colour. The colour is a good index of age and gradually fades away from a bright fawn to pale-grey as the eggs grow older. After a couple of days of incubation the eggs become slightly flattened dorsoventrally. Between the 3rd and 5th day a few dark spots (stumps) or tubercles appear towards the margin and these develop into appendages on the 5th or 6th day. Most of the eggs hatched after 7 days although the range of incubation period was from 6 to 9 days.

For the first two days after hatching the larvæ remain sluggish; later on they become very active as if in search of food (host). In the beginning they are quite plump, bulging out dorsally, till about the twentieth day when they become weaker and thinner. By this time the body juices have dried up and ultimately the larvæ become thin and leathery with well-defined margin and disinclined to crawl about. Some of the freshly hatched larvæ were kept under starvation when moulting took place as was evident from the cast off skins found in the tubes. Regarding the period of survival of the larvæ my observations reveal that a period from 56 to 113 days under varying climatic conditions is possible.

*Acknowledgement:* I am grateful to Dr. B. C. Basu, Entomologist, Indian Veterinary Research Institute, Izatnagar, for allowing me access to his private library and to Dr. M. B. Lal, Reader in Zoology, Lucknow University, for his guidance, helpful suggestions and criticism in the preparation of this paper.

Animal Husbandry Dept., United Provinces, Lucknow, November 25, 1948.
S. H. QURESHI.

1. Sories, A. S. *Rev. App. Entom.*, 1922, **10**. 2. Newman, L. J., *J. Dept. Agric.*, W. Australia, 2nd ser., 1924, No. **1**. 3. Salisbury, S., *J. Rhod. Agric.*, **1938**, **35**, No. 1. 4. Rovida, R. J., *Inst. Parasit.*, *Enferm*., I, 1940, fasc. **6**.

## PREPARATION OF AMYLOSE BY THYMOL PRECIPITATION METHOD

A number of methods have been suggested from time to time for the preparation of amylose component of starch. The more recent one is that of Haworth, *et al.*[1] and the principle of the method is that amylose can be precipitated as a water insoluble complex by thymol. This method is stated to be free from certain difficulties encountered in the earlier methods. We followed this method and found that the purity of the sample was not as good as the one prepared by Hassid's method, *i.e.*, by precipitation with Methanol.[2] By a slight modification of Haworth's method described in this note, we obtained amylose of purity comparable to that prepared by Hassid's method.

The effect of temperature and duration of heating on the extraction of amylose from starch without rupturing the granules was studied and the optimum conditions for the maximum extraction of amylose were established.

Starch was dispersed in water and poured into water at 80° C. (to make a 1% solution) and kept at that temperature for 1½ hours, with frequent stirring. The solution was allowed to cool down to room temperature and centrifuged. To the clear water extract of the amylose thus obtained, are immediately added sodium chloride to make a 0·1% solution and then thymol to saturation. The precipitation of thymol amylose complex starts almost immediately and is complete in about 24 hours. The precipitate was centrifuged off, washed with thymol water, absolute alcohol and ether. The yield and purity of the amyloses prepared as above and by Hassid's method are showing the following table. The

| Method followed | Blue value | Yield % |
|---|---|---|
| Present modified method .. | 252 | 13–15 |
| Hassid's method .. | 250 | 10–11 |

purity of the amylose samples are expressed in terms of blue units, determined according

to the method of Hassid and McCready[2] using a Klett-Summerson Photoelectric Colorimeter with the red $K_{66}$ filter. Sweet potato starch was used for preparing the amylose samples.

Similar results were obtained with amylose samples prepared from potato and corn starches.

S. LAKSHMANAN.
J. SRI RAM.
K. V. GIRI.
Dept. of Biochemistry,
Indian Institute of Science,
Bangalore,
*November* 30, 1948.

1. Haworth, Peat and Sagrott, *Nature*, 1947, **157**, 19.
2. McCready and Hassid., *Jour. Am. Chem. Soc.*, 1943, **65**, 1154.

## "VARAGU", *PASUPALUM SCROBICULATUM* (LINN.)

THE millet known as "Varagu" (Tamil), Kodra (Hindi), *Pasupalum Scrobiculatum* (Linn.) is extensively used as a staple food by poorer classes in all parts of India. In 1946, when rice was rationed, the Government of Madras compulsorily required part of the rice to be replaced by varagu by those who were accustomed to use millets as food. Various complaints were received that some varieties of Varagu consumed were producing poisonous symptoms. On the recommendation of one of us (K. V. S.) a Committee consisting of the Surgeon-General, Director of Public Health, Director, King Institute, the Govt. Analyst, and the Millet Specialist was constituted and they recommended that Government should undertake, through the Government Analyst, an investigation of Varagu Poisoning.

Some samples were found to be toxic to dogs. Stas Otto method was negative showing that the poison was not an alkaloid. But as a number of samples were found to be undoubtedly poisonous to dogs a systematic investigation was attempted. It was found that the fat residue obtained from extracts with petroleum ether (B.P. 60—95° C.) or chloroform was definitely toxic. The fat gave the following figures: (average)

Melting point 42° C.
Refractive Index (60°C.) 1·4650
Iodine Value 93·6
Saponification Value 107·7

of the fat contained in 50 grams of the millet 1·5 grams when fed to dogs, developed tremours within two hours. The dogs soon lost their power of movement and died within 24 hours. Attempts to feed monkeys with the fat failed as they refused to take the food Subsequently we found that when the fat was injected subcutaneously into dogs the symptoms described above were observed. We were able to reproduce the symptoms in monkeys by intramuscular injection. Crows were found to be extremely susceptible to both oral ingestion and intramuscular injection. After ten minutes of taking the food they vomit the food, the pupils become fixed, they droop their heads, soon lose power of moving and are dead in 24 hours. The fat is stable to heat but the toxin in the fat seems to be easily destroyed on heating with dilute alkali and acid. It could not be an alkaloid as it is not taken up in acid solution or a glucoside as it is not taken up by water or 90% alcohol. The poison seems to be adsorbed chromatographically on silica column and further experiments are in progress.

These facts seem not to have been recorded in literature so far as we are aware, *viz.*, of a fat derived from a millet having been found to contain a substance which is poisonous to man and animals. Our findings of the effects by intramuscular injection on dogs, monkeys and especially on crows should provide a new method of approach for studying the presence of poisonous elements in fats and of estimating the lethal doses.

A simple colour test based on the reaction of concentrated sulphuric acid on the fat is being worked out to distinguish the poisonous variety of Varagu from the non-poisonous variety of Varagu.

K. V. SUNDARAM AYYAR.
K. NARAYANASWAMY.
Government Analyst Laboratory,
Guindy, Madras,
*December* 1, 1948.

## DIRECTOR-GENERAL OF UNESCO

DR. JAIME TORRES BODET, Foreign Minister of Mexico, has been elected the new Director-General of the United Nations Educational, Scientific and Cultural Organisation.

Dr. Bodet, born in Mexico on 17 April 1902, received his education in that country. An eminent author, and former Minister of Education in Mexico, he has written three volumes of poetry, six novels, and many books on education. For his outstanding work in the educational field, the University of Mexico and the University of Southern California conferred on him the honorary title of Doctor in Letters. He is also an active member of the Mexican Academy of Languages. While with the Ministry of Education, Dr. Bodet organised a system of public libraries throughout Mexico, and assisted in the translation of the classics which were published by the Mexican Government. He was Professor of French Literature in the Department of Philosophy and Letters in Mexico from 1924 to 1928.

He entered the Foreign Service in 1929 and held diplomatic positions in Spain, Holland, Belgium and France.

In 1943 he was appointed Minister of Education, at which time he initiated the world famous Mexican campaign against illiteracy. In November 1945 he headed the Mexican delegation to London, and attended the Conference which created Unesco. He was one of the original signers of the Unesco Charter.

He has been Foreign Minister of Mexico since December 1946, and in that capacity led the Mexican delegation to the Inter-American Conference for the Maintenance of Peace. He was also head of the Mexican delegation to the Second General Assembly of the United Nations, where he was elected Vice-President.

Dr. Bodet will assume his duties as Director-General of Unesco in Paris at the beginning of 1949.

# REVIEWS

**Natural Philosophy through the Eighteenth Century and Allied Topics.** Edited by Allan Ferguson. (Taylor & Francis Ltd., London E.C. 4), 1948. Pp. i-vii, 1-164. Price 15 *sh*.

The volume under review has been issued as Commemoration Number to mark the 150th Anniversary of the foundation of the Philosophical Magazine and forms a welcome addition to the growing literature on the History of Science.

The opening chapter by Ferguson and Ferguson contains a vivid account of the beginnings of the Magazine in 1798 and gives many interesting details about the personalities of Alexander Tilloch, Richard Taylor and Dr. William Francis who between 1798 and 1904 did yeoman service in the matter of editing and publicising the Magazine. In a rapid survey of its history over a long period, the authors convince us that the Philosophical Magazine has had its share of important publications in the scientific field, *e.g.*, by Rowland, Hamilton, Lord Kelvin, Michelson, Morley, J. J. Thomson, Rutherford, Bohr, Mosley, Chadwick and Millikan, to mention only a few.

The history and progress of Natural Philosophy in the 18th century is dealt with under four headings in the next four chapters: Astronomy by Sir H. Spencer-Jones, Physics by Herbert Dingle, Chemistry by J. R. Partington, and Mathematics by J. F. Scott. The authors in the respective fields must be congratulated for the remarkable sense of perspective and proportion which they display in dealing with the necessarily vast amount of data on the subjects due to the immensely detailed development of scientific thought in the 18th century.

The impression one gets of Natural Philosophy in the 18th century on reading through these 80 pages is of a period in which the great mathematical physicists such as Clairut, D'Alembert, Lagrange, Laplace and others vie on the one hand with the astronomers such as Flamsteed, Halley and Herschel, and on the other, with the physicists and chemists such as Rumford, Coulomb, Priestly and Lavosier in wresting secrets from the womb of Nature. The galaxy of great names too numerous to be mentioned in full pass and many times repass delightfully before our vision.

The rest of the volume is devoted to a consideration of the status of topics allied to Natural Philosophy. In a chapter devoted to Engineering and Invention, Captain Edgar C. Smith has given an excellent picture of the manner in which the rising tide of scientific thought in the century reacted upon industry in a very favourable manner, enabling men like James Watt, Richard Arkwright and Hargreaves to revolutionise manufacture and industry by their many beneficial inventions.

In the chapter devoted to Scientific Instruments, Robert Whipple presents many a great name in the History of Science of that period in the novel role of instrument designers and instrument makers, which it will be realised remains as important a branch of science today as it was then. We meet here Huygens inventing a pendulum, Hooke devising the anchor escapement, Farenheit perfecting the first modern thermometer, De Luc making a barometer, Ramsden shaping an eye-piece, Martin at work on the microscope, von Kleist busy with the Leyden Jar, Coulomb constructing his torsion balance and Volta assembling the first battery in the history of electricity.

The last three chapters provide a good deal of interest to the earnest student of the History of the Science not unmixed perhaps with a little amusement also. Dr. Doughlas McKie takes us to the very scene of the struggles of the Scientific Periodical, in attaining to a position of independence when they had no longer any necessity to provide "entertainment" for the benefit of the leisured amateurs in return for their patronage. The same author has made an able review of the increasingly useful role of Scientific Societies in the century.

The last chapter by Sherwood Taylor on the Teaching of Science in the 18th century is of absorbing interest, in showing clearly that eminence in science is largely then as now a matter of personal taste and intense application, nurture and opportunities of course playing their due part.

We have no hesitation in saying that judged even by the standards of the Philosophical Magazine the volume under notice attains to a degree of all-round excellence, well worth maintaining. H. R.

---

**General Biology.** By James Watt Mavor. (Macmillan Company, New York.) 3rd Edition. 1937. Pp. 986. Price. 27*sh*. 6*d*.

Dr. Mavor has brought out a third edition of his "General Biology," in which some of the chapters have been revised, and additional material presented on the structure of matter and organic compounds. This is a book attempting to present a general picture of the major branches of Biology, for the benefit of the elementary student, and for those in charge of such instruction. The science of Biology is such a vast one, and its frontiers are expanding at such rapid pace, that it is almost impossible to give even a general picture of the whole subject in the compass of a single volume. The author has obviously failed to achieve the impossible, and the book betrays a series of compromises, between the requirements of the School and the College, between the teacher's freedom and the student's need, between type method and the general discussion method, between morphology and physiology, between comprehensiveness and concern for fundamentals, between bulkiness and primer-like treatment.

The book is divided into six parts. The first part deals with a general account of the nature of life, and is intended to serve as a general

foundation for the study of material presented in later chapters. This part is well written. Chapters 4, 5, 6 and 7 of Part I, entitled respectively, the Cell; chemical elements and inorganic compounds; organic compounds, colloidal systems and membranes; and Cell Physiology, attempt to give within a fairly brief compass a foundation in chemistry and physiology which is indispensable for understanding the new orientation that has come about in biological studies in recent times. It is very unusual to find these topics discussed in biological books in a manner understandable to the beginner. It is high time that every teacher of biology insisted on his students getting a grasp of the material of these chapters.

The second part deals with plant life and briefly considers examples from the main groups of the plant kingdom, beginning with the blue-green algæ and ending with the flowering plants. The treatment of such a large topic in the space of about 160 pages, including illustrations, is necessarily very brief. It is very satisfactory to note that in dealing with the morphology of representative types, the evolutionary aspect is kept in mind. This certainly helps the student to get a picture of the plant kingdom as a whole, and impresses on him the evolutionary connection between apparently isolated groups of plants.

A similar plan as in Part II is followed in Part III, entitled "Invertebrates". Again, sufficient justice is not done to the vastness of the subject.

Part IV dealing with vertebrate anatomy and physiology based on the frog and man errs in the opposite direction. These two parts are apt to give a wrong impression to the student that vertebrates alone matter in the scheme of animal life, and that what is true of the frog and man is also true of all animals. This imbalance is the inevitable result of the attempt to effect a compromise between the system of treatment based on full and detailed description of particular types and that which avoids types and concentrates on general description.

The fifth part dealing with the development and heredity in plants and animals is treated in a most elementary manner. The science of heredity is one of the most important branches of biology, and the attention it deserves has not been paid in this section.

The sixth and the last part dealing with the organic world and its evolution is well written and should be stimulating to the student who has already taken his first lessons in biology.

After going through the book one cannot help the feeling that the book is somewhat loosely knit. The author says that "the order in which material is presented has been chosen both with regard to the logical development of the subject and to close correlation between laboratory and classroom work. Nevertheless this order need not been strictly adhered to as *the parts of the book are to a considerable extent independent* (italics mine). To give latitude to the teacher and make possible variations in the course from year to year in a number of cases alternate types have been discussed and sections have been written so that they may be omitted or included without serious loss of continuity". This is an admission of the essential weakness of the book. While aiming at this abstruse logical development he has introduced discontinuity in the grosser aspects of the book, which in a book professedly meant for the elementary student is an unfortunate drawback.

Notwithstanding the weaknesses pointed out above, the book contains a great deal of material, and some of the chapters are indeed very readable. The printing, illustrations and general get-up are very good. A. A.

---

Biology of Pathogenic Fungi. Edited by W. J. Nicherson. (Waltham, Mass., U.S.A., Chronica Botanica Co.; Calcutta, Bombay and Madras: MacMillan & Co. Ltd.), 1947. Pp. xx + 236. Price 5·00 dollars.

The book brings together results of fundamental investigations on different phases of the biology of fungi pathogenic to man which are essential for a thorough programme aimed at the prevention, prophylaxis and treatment of mycotic diseases. It provides an interesting and illuminating reading and has been presented in a clear and simple manner. The book is divided into twelve chapters and each chapter gives an up-to-date review of the subject concerned. The restraining influence of skin and dead epidermal structures on the growth of dermatophytes and the changes in such resistance occasioned by attrition in nutrition and the concomitant hygienic levels have been dealt with. Atttention is also drawn to the possible role of zinc present in highest concentrations in the parts of the body affected by dermatophytes in the defence against fungus invasion, the importance of studies on the enzyme elaborative abilities of the fungi concerned and the negative correlation between the nutritional requirements of a fungus and its pathogenicity obtained as result of investigations on the nutrition, metabolism and chemical constituents. In addition to the biology of *Torulopsidoidaceæ*, physiology, history, distribution and histopathology, etc., of *Chromoblastomycosis* have been fully dealt with. Mycological aspects of the disease have particularly found an adequate presentation. Nomenclature, nutritional requirements and cultural characteristics of *Pityrosporum ovale* the organism found in *Pityriasis* are also discussed. High incidence of *Coccidioidomycosis* has been correlated with the distribution of rodents in the endemic areas indicating an animal reservoir of the disease.

Action of sulphonamides on the pathogenic fungi has been dealt with at some length. The generally accepted "Paraminobenzoic acid theory" is explained and the fungistatic action of sulphonamides has been fully discussed. Although considerable success has been reported in case of certain diseases, need for further clinical experiments regarding sulphonamide therapy has been stressed. The book ends with an informative chapter on the respiration and fermentation of pathogenic fungi. Of the many fungi responsible for diseases of man, only a few have been investigated from the point of view of their oxidative activities and the chapter brings together available knowledge on the subject. Though

respiration of cells in general follows a basic pattern, it is well known that even related species carry out apparently identical oxidations by different catalytic mechanisms and pathways. The author compares the present knowledge of the oxidative and fermentation processes of pathogenic fungi with the more extensive information available for non-pathogenic forms. The book in addition to compiling together modern data on different aspects of the biology of fungi pathogenic to man, brings out the lacunæ existing in our knowledge of taxonomy, distribution, metabolism and therapeautic measures.

The different subjects have been dealt with by authorities on the particular items and the book in the present form of our knowledge leaves nothing to be desired and should be welcome by students of human mycopathology. Further, the book shows the importance of biological studies and other rational approaches to a knowledge of mycotic diseases, particularly in a country like India where, in spite of indifference of medical men and the consequent imperfect surveys, fungus affections have been known to constitute as high as 20 per cent. of the common diseases in contrast to America where fungus affections are reported to be 3·4 per cent. or even less.

R. S. VASUDEVA.

---

**Field Guide to Birds of the West Indies.** By James Bond. ix + 257, 1 coloured plate, 211 line drawings. Maps inside cover, front and back. Size 7½"×5". (The Macmillan Co.), New York, 1947. Price $ 3·75.

This little book is designed largely on the lines of Roger Tory Peterson's "Field Guide to the Birds" whose first appearance in 1934 literally took the bird watching public of the United States by storm.

"Its primary purpose", the author tells us, "is to enable the reader to identify in the field the various birds known to inhabit the West Indies", West Indies here meaning the Bahamas and the Greater and Lesser Antilles.

The descriptions giving local names, size, colouration, habits, nesting and range are usefully compressed, and in nearly all cases a well executed pen-and-ink sketch of the bird accompanies it, which should provide additional facility in identification. The arrangement of orders and families followed is mainly that of Peter's 'Checklist of the Birds of the World'.

A full index of local names at the end of the book is a useful innovation, particularly since the reader is advised to take with him an intelligent woodsman on his bird watching trips who will apparently be familiar with the birds by their local names and know where to find them.

In the descriptions, emphasis is laid on call notes and songs since in the dense forest many birds are more likely to be heard than seen. We doubt, however, if calls as printed in a book can convey much to the hearer who is not already familiar with them by ear. The difficulty of rendering bird calls intelligibly in print is one that many ingeniously devised systems of transliteration and notation have so far failed to overcome.

Some instructions are contained in the Introduction for the benefit of travellers regarding how to reach the remoter birdy spots of the islands etc. Among these the naive injunction that "Natives should at all times be treated with the greatest respect, but never with intimacy...." is reminiscent of the booklet of exotic precepts contained in the booklet of instructions with which American soldiers during the war were armed by their thoughtful Government for correct department with the natives of India.

The chapter ends with a plea for the creation of sanctuaries for the preservation of West Indies birds, many of which have become very rare and are in grave danger of extinction.

The book should serve its primary purpose admirably, and may be taken as a model of the type of bird book that we in this country want for each province and unit of the Indian Union.

S. A.

---

**International Rules of Botanical Nomenclature.** Compiled from various sources by W. H. Camp, H. W. Rickett & C. A. Weatherby. (Publishers: Waltham, Mass.: The Chronica Botanica Co., Calcutta, Bombay and Madras: Macmillan & Co. Ltd.), 1948. Pp. 120. Price $ 3·50.

The Chronica Botanica Co. has done an important service to Systematic Botany by publishing the International Rules of Botanical Nomenclature, as preparations for the holding of the next International Botanical Congress in the near future are actively being made. As copies of the last (3rd) official edition (1935) of the Rules were no more available, and as the Amsterdam Congress in 1935 had made additional changes in the Rules published earlier in that year, it was necessary that these should be made easily available to workers in Systematic Botany, many of whom were not likely to know them. This purpose has been served by the present publication, which is a careful compilation based on authentic materials and includes the official text of the Rules as amended at Amsterdam, together with the draft proposals submitted to the congress on matters included in several appendices, which have not yet been adopted officially. The authors are careful to point out that the present text, although taken from authentic sources, is in no way to be considered official. The format and get up of the volume are similar to that of the last official edition. The text is *only* in English instead of in English, French and German.

In view of the fact that the International Rules of Nomenclature are not generally known to the younger Indian Botanists and also to some seniors, we give below a comparative statement of the contents of this volume and the last (1935) official edition. In the main body of the rules only a few minor typographical errors which came to the notice of the compilers have been corrected.

Appendix I includes certain recommendations regarding the naming of fossil plants

made at the section of Palæobotany of the Congress at Amsterdam in 1935.

Appendix II contains a list of "Nomina Familiarum Conservanda" proposed by J. Lanjoux and T. A. Sprague, *not* adopted by the congress. This was not printed in the last edition.

Appendix III "Nomina Generica Conservanda" has been prepared in a different form from that of the 3rd (1935) edition of the Rules. Whereas in the 3rd edition, names adopted for conservation were printed separately from the proposals for conservation by various persons which were included in a supplement "Nomina Generica Conservanda proposita" the present compilation has combined these two lists indicating by suitable means the names definitely adopted for conservation by the Congress. The provision of an index to this part facilitates consultation. We feel, however, that it would have been better to have kept the two lists separate.

No proposals for Appendix IV "Nomina Ambigua", Appendix V "Nomina Confusa" and Appendix VI "Representative Botanical Institutions recognized under Act 36" having been received these appear as titles only. Appendix VII "Nomenclature of garden plants" by A. B. Rendle and a list of "Standard-species of Linnaean Generic Names of Phanerogams" as proposed by A. S. Hitchcock and M. L. Green, have been printed as in the official edition.

Altogether the compilation is a very useful one for working systematists and we recommend that every college and University library in India should obtain a copy.

S. P. A.

---

**The Skin Diseases—A Manual for Practitioners and Students.** By James Marshall, Consulting Dermatologist, Central Middlesex County Hospital, etc., etc. (Macmillan & Co. Ltd., London), 1948. Pp. x + 363. Price 30*sh*. Net.

Chapters I and II are devoted to the description of Anatomy and Physiology and the pathological changes met with in skin diseases in general. There is a chapter on syptomatology and chapter on the procedure of examination of skin diseases and the method to arrive at diagnosis. Diagrammatic sketches are given for the distribution of lesions in different types of diseases. Principles of treatment of skin diseases with a few useful recipes are discussed in Chapter V. The author has exhaustively classified the skin diseases on ætiological basis, *viz.*, Congenital abnormalities, physical agents such as heat, cold. X-ray, radium, etc., infectious fevers, pyogenic infection, syphilis, tubercle, leprosy, viruses, animal parasites like scabies, bacillary diseases like anthrax, etc., various kinds of epidermophytes, lesions of obscure ætiology like psoriasis, pityriasis, etc., diseases of toxic and allergic origin such as Eczema, erythema, urticaria, etc., drug eruptions, neurodermititis, pigmentary disturbances and various other causes. He has included a chapter on psychological aspects of skin diseases. It is not unusual for one to meet with patients who attribute their skin trouble to a previous nervous strain of shock or some kind of emotional disturbance. During the last war a number of cases of skin trouble were reported from among the prisoners of war. It may be possible that those cases were partly psychological and partly due to causes environmental and nutritional, because some of those cases recovered without further treatment when those persons were restored to normal life. In this small volume the author has given detailed discriptions of symptoms and treatment up to date. The book is copiously illustrated and a number of coloured plates are added to make a difficult and complicated subject very instructive. This manual should amply fulfil the authors purpose.

K. P. MENON.

---

**The Advancement of Science, Vol. V.** (Published by the British Association for the advancement of Science, Burlington House, London, W.I.), 1948.

The present number contains a large number of articles presented before the meeting of the British Association in Dundee in 1947. A wide variety of subjects have been discussed and reported. They range from subjects on "Mathematics", Insecticides, Human factor in Industry and finally end with a paper before the physics section on "Location of Thunderstorms by Radio".

A general survey reveals that, a large number of papers have been read before the various sections such as chemistry, physiology, agriculture, social and international relations of science and physics and discussions reported. It is encouraging to find in these articles a clear, practical and realistic approach to many of the applied problems in Agriculture and Social Sciences.

Discussing the Human factors in Industry under the Presidentship of Sir Henry Tizzard, F.R.S., the report records an interesting note on working conditions by Prof. Laue and human relations by Dr. Tredgold.

The problem of environmental conditions in Industrial worker and the method of helping to solve it on the preventive side by the Medical Officer-in-charge are made clear. Attention is pointedly drawn to the human wastage from disease and accident being maximum in miners. The important role played by engineers in lay-out and proper design to eliminate monotony and accidents. It is felt that to eliminate bad group morale, the industrial worker must be approached individually and taught simple methods of increasing and improving work. In the long run, better methods of honest co-operation are needed, and a large use of the present findings to future planning will help to solve the problem of the industrial worker.

The other useful articles are written with a view to enable even the layman to appreciate the findings of applied research in agriculture and industry. By these frequent meetings, discussions and records in the various fields of

science, the British Association, one of the oldest bodies in promoting the advance of science is performing a work which deserves praise from all quarters. The present number of the Journal, fully endorses the pioneering efforts of the Association in the advancement of science in all its branches. The journal serves as a happy balance between theory and practice of science which we so sorely need to-day.

T. N. R.

---

Cytogenetics and Plant Breeding. By S. N. Chandrasekharan, and S. V. Parthasarathy. (Publishers: P. Varadachary & Co., Madras. Pp. 589. Price Rs. 12-8-0.)

Genetics as applied to agriculture, is comparatively young, and plant breeding which about fifty years ago, was merely a toy and a hobby in the hands of a few rich and those interested, has today assumed the status of what is commonly called an exact Science. And in the present times no plant-breeder can be successful in his work unless he has a sound basic knowledge of the fundamentals of cognate sciences like, cytology, taxonomy and statistics. The chromosome theory of heredity is now an established fact, and many a genetical phenomenon, which formerly defied explanation, can now be interpreted on the basis of chromosomal structure, morphology and behaviour. As a natural corollary, while the plant-breeder of olden times achieved results through observations, which were necessarily long drawn out for the reason that they were neither scientific nor based on an understanding of the fundamentals of the mechanism of heredity, his present-day counterpart is able to synthesize new species almost at will incorporating therein, the desired characters, like increased yield, resistance to fungal or virus attack, earliness of flowering and the like. Much work in this direction has been done and useful results achieved in U.S.A., U.S.S.R., Sweden, England and until the outbreak of the war, Japan. The evolution through breeding, of different varieties of wheat, maize, apples, strawberry, etc., is known to almost everybody.

While we all know so much about work done, and success achieved elsewhere, little or next to nothing has been known even to us, let alone the outside world, about the work done in our own country. If, for nothing else, the authors of the book under review have to be congratulated for the care with which they have unearthed and laid before the student of Genetics, the bulk of the work and the data that lay buried, in agricultural journals and inaccessible departmental bulletins. The achievements of our countrymen in the field of plant breeding and genetics, may compare very favourably with those of other countries, when due allowance is made for the fact that, having been under the yoke of foreign domination, full-hearted encouragement has not been forthcoming for the free display of our Natural talents; nor was there much anxiety on the part of the alien rulers to build up on true foundations, those nation-building departments, like Education and Agriculture, whose proper set up and functioning would have meant all the difference between poverty and prosperity in the country. If in spite of these handicaps, so much has been accomplished, it is a matter to be proud of and even made much of. Sir T. S. Venkatraman's work, on the sugarcane made India self-sufficient in sugar; less spectacular, but no less important has been the work done by our men in respect of rice and millets.

The results of and the data incidental to these, have not been incorporated in any text-books so far, such that they could be used in colleges, for teaching purposes. We have always relied upon Mendel's peas and other foreign examples to clarify genetical principles. And now for the first time, thanks to the authors of the book, it will be possible to illustrate the principles of heredity with examples taken from the researches made in our country.

The general principles of Genetics have been well enunciated and explained, with the aid of suitable examples, and diagrams taken principally from the works of various Research Divisions. Details have been given of pure line selection, and clonal selection, as practised in the Coimbatore Research Station, and a list of new rice and millet strains so evolved by the Madras Agricultural Department, has been catalogued.

In the evolution of new and improved varieties, the part played by hybridisation, accompanied or unaccompanied by chromosome duplication, has been duly emphasised. Results achieved by this means in Rice, Sugar cane, Cotton, &c., have been justifiably elaborated. Polyploidy and its artificial induction have received ample attention at the hands of the authors.

As plant-breeding is now a highly developed science, it cannot achieve its purpose, unless field experiments are very carefully designed, and the data statistically analysed. The authors have, therefore, done well in giving due prominence to statistics in relation to plant breeding. Copious details have been given of field plot technique and the appendices at the end of the book include gene symbols for paddy, cholam and cotton, and chromosome numbers of some of the more important Indian species of Angiosperms. It is not clear on what basis the list has been drawn up. It does not seem to be confined to economically important plants, though the bulk of the list is comprised of these. It would be worth the while of the authors in the next edition of the book to draw up a fairly complete list of chromosome numbers of all Indian species, wild and cultivated, with proper references. As it is, the list is scrappy with several important omissions, like palms, Aizoacea, and several other Angiospermic families.

A very useful glossary has also been appended. Though the book is one on plant breeding, a short chapter on human genetics would not have been out of place. It might have served to indicate how heredity in man has to be studied by methods which are different from those used for plants. As people are never bred for experimental pur-

poses, only inferences can be drawn from data collected from pedigrees. Interrelationships in plants that could have been obtained with certainty from pre-arranged experiments have only to be inferred by actuarial methods, in the case of human heredity.

Though the fundamental principles are the same in both, the plant-breeder should know, how the problems connected with human Genetics, should be approached and tackled as distinct from those of plants.

On the whole, the book should be welcomed with open arms, by all students of genetics, especially in this country. It is the first of its kind and the authors deserve the gratitude and congratulations of the Scientific World of India for having collected and placed before them in textbook form a mass of data which otherwise would have remained, scattered, and unco-ordinated and consequently useless. The book should find a place not only in all the libraries but also in the hands of every student who studies Botany either in its academic form as in Science Colleges, or in its applied form as in Agricultural College.

T. S. RAGHAVAN.

## MARVELS OF FISH LIFE*

TO Dr. Schultz, the senior author of this work, fishes are the most fascinating form of animal life in the world. He has studied fishes in all continents, in lakes, rivers and seas, and in the atom-bombed atolls of Bikini. As the Curator of fishes of the Smithsonian Institution, the subject is to him both a vocation and a hobby. He tells us that his interests in fishes began from his boyhood but soon developed into a serious pursuit. "And the more I learn about fishes, the more I marvel at their variety and the colour and drama and odd quirks and excitement of their ways". His objects in writing this book is to share with others who are not ichthyologists, at least a little of the enjoyment which he and his colleagues get out of knowing the bizarre, astonishing and manifold ways of their favourite animals. The work is addressed to the general reader and not to the specialist, but the non-technical language and the narrative style giving information in the form of personal adventures and anecdotes do not in any way affect the accuracy of observations. In fact, there is a great deal of natural history that is new in this work even for the specialist who has spent most of his time studying fishes in the laboratory.

The opening section deals with the problem of migration in fishes with an account of the life-history of the European freshwater eel and the epic journey it makes to the Sargasso Sea to spawn, all made known to science by the classical researches of the late Johan Schmidt, the Danish Biologist and Physiologist. Unlike the eel that travel to the ocean to spawn there is the salmon which have the strongest homing instinct to come back for breeding to the freshwater streams where they hatched out and spent the early stages of their life-history. These are two extreme cases of migration but there are countless others where a definite migratory journey either for feeding or for reproducing the kind is performed with un-erring instinct. We are next told of the means of locomotion in fishes, of the fishes that jump, glide, fly, walk, skip and burrow. Many of the burrowers can, by hibernation or aestivation, tide over unfavourable conditions of the surroundings caused by extreme cold or by heat and disiccation. In the latter category are found some of the most interesting fishes of the world, for, they herald the lung breathing habits of the more advanced vertebrates The authors discuss the habits of the lung fishes, *Protopterus*, *Lepidosiren* and *Neoceratodus*. Under "Fishes dangerous to man" we read of the sting ray and a few of the less poisonous fishes, followed by the *piranha* of the Amazon, one of the most bloodthirsty fishes of the world, attacking man and beast without provocation, and vicious out of all proportion to its size, so much so that writers of detective fiction have not hesitated to employ it as an instrument of murder. The man-eating sharks and the large tropical *barracuda* get their due share of attention as enemies to man as also the swordfish which used to be so much dreaded in the days of wooden ships. The *Candiru*, the only vertebrate parasite of man is not so well known; this tiny South American catfish enter the sex organs of humans while bathing or swimming in water and cause unbearable pain and often prove fatal to the unfortunate hosts. Among the poisionous category are many like the *puffer* whose flesh is definitely known to be poisonous; others less dangerous but none the less best avoided include *Ruvettus pretiosus* the "purgative fish". It is reassuring to hear, however, that not all fish now known as poisonous need be so, for, we are told that the fish that sustained a sailor adrift on a raft for several weeks after he was torpedoed in the high seas during the war happened to be the file-fish usually considered poisonous!

Feeding habits, association with other animals and fighting qualities are briefly discussed in the succeeding sections. We are told of *Dermogenys* and *Betta* which have been most assiduously bred and cultivated for centuries in Siam. The matched combats arranged between male *Betta*, one of the most handsome fishes even in its wild state, provide much amusement to the Siamese. On good authority we have it that there is nothing cruel about fighting *Betta*. "The rankest sentimentalist need waste no sympathy on the fighting fish-its physical discomfort is negligible, its recovery from its minor injuries is complete, and it seems to derive great satisfaction from its particular form of sport. So does the human onlooker".

* *The Ways of Fishes*. By Leonard P. Schultz and Edith M. Stern. (D. Van Nostrand, New York, and Macmillan, London), 1948. Pp. 12 + 1-264. 80 Text illustrations, Price $ 4·00 or 22 *sh.* net.

Production of light and electricity by fishes has always excited popular imagination but it is only recently that the physiology of these phenomena has been diligently pursued and, as yet, we know so little. An average sized individual of *Electrophorus electricus*, the electric eel of South American rivers, can produce discharges of about 550 volts; investigators have drawn from an eel almost 600 volts and about 1,000 watts. We are, at present, not in a position to utilize this tremendous output of electrical energy because this impulse is passed and gone in about two one thousands of a second. There are many fishes that light up their surroundings in the dark abysses of the ocean but only one is known which can glow and sing; this one, *Porichthys*, found on the Western Pacific coasts shows rows of shining buttons when disturbed, accompanied, in the male, by a humming sound. Sense of hearing and sight are also discussed. Fishes have no external ear, nevertheless they have an efficient system of sense organs along the lateral line, some of them reacting exclusively to sound. Eyes are well developed in all except the deep-sea dwellers; some have even specialized eyes not unlike bifocal spectacles, the upper part for vision in air, the lower for vision in water.

The most distinctive features of fishes are in regard to their spawning habits. Many individual traits are seen. Some are ocean beach spawners; others are nest builders in streams; in every instance there is perfect accord of the habit and habitat of the species. "But the facts of such adaptations for survival, the fascination of their detail and the grandeur of their mass drama, and their ages-long rhythmical repetition make ichthyology such a continuously stirring and wondrous field of exploration".

Not much attention is paid to the commercial aspect of fisheries but the authors have indicated the basic facts of fisheries management under the head "Fishes controllable by man" where we are given an account of the work on the North Pacific Halibut. The last few pages are devoted to the care and maintenance of aquaria and the choice of aquarium fish; these sections would be particularly welcome to the amateur aquarist and fish collector. A classification of fishes up to Families is appended.

The authors have presented a most enjoyable contribution to fish lore which the layman and the serious worker will find of equal interest. It is a pleasure to find such undiluted natural history which has, in these days of specialization, almost disappeared from modern publications.

N. K. PANIKKAR.

# SCIENCE NOTES AND NEWS

## Royal Society Medallists of the Year

The two Royal medals for the current year went to Professor Harold Jeffreys, F.R.S., for his work in geophysics and his contribution to the astronomy of the solar system, and to Professor James Gray, F.R.S., for his researches in cytology and ciliary movement, and particularly his anatomical and experimental studies of animal posture and locomotion.

The five awards made by the President and Council of the Royal Society are:

The Hughes Medal to Sir Robert Watson-Watt, F. R. S., for his work in atmospheric physics and in the development of radar;

The Darwin Medal to Professor Ronald Fisher, F. R. S., of Cambridge, whose subject is "The Effect of Blood on Evolution";

The Davy Medal to Professor E. L. Hirst, F.R.S., for his work in the determination of the structure of sugars, starches, plant gums, and especially of Vitamin C; the Rumford Medal to Professor Franz Simon, F.R.S., a refugee from Nazi Germany, who helped to produce the atomic bomb, and who won the award for his study of intense cold, having produced the lowest temperature ever recorded—nearly Absolute Nazo (*minus* 458 degrees Fahrenheit);

The Copley Medal to Professor A. V. Hill, F.R.S., for his researches on myothermal problems and on biophysical phenomena in nerves and other tissues.

## Protection of Nature Conference

The Conference for the establishment of the International Union for the Protection of Nature which has been meeting at Fontainebleau (France) since September 30th, concluded its proceedings today (7 October 1948).

The meeting was called by the French Government in association with Unesco to draft and adopt the final constitution of the Union which was provisionally created last year at the Conference at Brunnen (Switzerland).

The Constitution, signed by 17 governments and 20 organizations, provides, *inter alia*, that the Union:

(*a*) shall encourage and recommend national and international action in scientific research relating to the protection of nature;

(*b*) shall promote and facilitate co-operation between governments, organizations and persons interested in the protection of nature;

(*c*) shall collect and disseminate information on that subject.

The signatory governments will also establish an extensive programme of education in this field and prepare international draft agreements and a world-wide Convention for the Protection of Nature.

The Conference also took the opportunity to hold a technical symposium to discuss nature protection problems with special reference to Europe and Africa, and has by this means set up Regional Study Groups for

Europe and Africa to crystallise the views on subjects due off discussion at the Unesco Technical Conference on Nature Protection, which the Director-General of Unesco will urge the Third Session of the General Conference to convene in the same place as, and in co-operation with, the United Nations Scientific Conference on the Conservation and Utilisation of Natural Resources, in June 1949.

The Governments which have signed the Constitution of the International Union for the Protection of Nature are: Argentina, Australia, Belgium, Brazil, Dominican Republic, Egypt, France, India, Italy, Luxembourg, Norway, Netherlands, Poland, Siam, Switzerland, Syria, Venezuela. *(By courtesy of the Principal Scientific Officer, Unesco, New Delhi.)*

## Unesco Grants $7,500 to Council for Philosophy and Humanistic Studies

The United Nations Educational, Scientific and Cultural Organisation is to make a grant of $7,500 to help the International Council for Philosophy and Humanistic Studies in the early stages of its work.

The grant, Dr. Julian Huxley, Unesco's Director-General, explained, was being made in accordance with the usual practice of Unesco of supporting a promising infant.

Delegates from five international, non-governmental bodies have already met at Unesco House, Paris, to approve a provisonal Constitution and set up a Preparatory Commission for the Council.

In the words of the Constitution, the Council is, *inter alia,* to co-ordinate the dissemination of information regarding works published or begun in the field of Philosophy, Humanistic Studies and related branches of study and to encourage the setting up of international organizations in fields in which no such organizations exist.

## Geomagnetic Storms

Some details of the geomagnetic storms as recorded at the Alibag Magnetic Observatory during the quarter July to September 1948 are given in the following table in which $t_0$ $t$ represent the time (I. S. T.) of commencement of the disturbance and its intense phase respectively and T the duration of the intense phase expressed in hours. The ranges in the three different elements (D. H and V) of the earth's magnetic field have also been given, D, in minutes of arc, H and V in $\gamma$ where $1\,\gamma = 10^{-5}$ gauss. The maximum k-index ($K_m$) recorded during the disturbance has also been given.

| Date | $t_0$ | $t$ | T | Range | | | $K_m$ | Nature of commencement |
|---|---|---|---|---|---|---|---|---|
| | | | | D | H | V | | |
| | h. m. | h. m. | hrs. | min. | $\gamma$ | $\gamma$ | | |
| 1948 August 8–11 | 4 29 | 8 30 | 20 | 8·6 | 275 | 17 | 7 | Sudden |

## Radiolympia 1949

Britain's 16th National Radio Exhibition (Radiolympia) is to be held at Olympia, London, from September 28 to October 8, 1949. This has just been announced by the Radio Industry Council.

Her Majesty Queen Mary has again consented to be the patron of the exhibition.

Radiolympia was last held in 1947 when it was attended by close on 400,000 people.

## United Nations' Invitation to Dr. S. L. Hora

Mr. Trygve Lie, Secretary-General of the United Nations, has invited Dr. S. L. Hora, Director, Zoological Survey of India and formerly Director of Fisheries, Bengal, to prepare a paper on *Pond Culture of Warm Water Fishes* for presentation to the United Nations Scientific Conference on the Conservation and Utilization of Resources to be held in the United States of America in May or June 1949.

## Jute Committee's New Secretary

Dr. J. V. Lakhani, M.Sc., A.I.I.Sc., Ph.D. (Edin.), has taken over charge on the 2nd December as Secretary, Indian Central Jute Committee, from Mr. G. C. Sen, whose term has expired.

Dr. Lakhani was the Dean of the Faculty of Science, D. J. Sind College, Karachi, and has had wide experience of administration and research. He has travelled extensively and has published several papers on academic and industrial subjects in Chemistry.

Dr. Lakhani has been taking keen interest in the problems connected with Jute Production and industry and it is expected that his rich and varied experience will prove of immense help to the Jute organisation of the Government of India.

## Bombay-Kaushika Prize for 1947

The Sugar Technologists Association of India, Kanpur, have awarded the Bombay-Kaushika Prize to Mr. K. M. Gururaja Rao of Mysore Agricultural Service (Retired), Bangalore, for his publication "Sugarcane Cultivation". He was the Agricultural Officer to the Mysore Sugar Co. and organised, from scratch, sugarcane growing and supply to the factory working for 250 days in the year and crushing daily 1,500 tons. Similar work was done in Central India for the Bhopal State Sugar Industries Ltd., Bhopal. The book was reviewed in the *Current Science* of June 1947.

## Change of Address

The Information Section of the Department of Scientific and Industrial Research has moved to Lower Regent Street. For the time being the remainder of Headquarters of the Department will remain at 24 Rutland Gate, London, S. W. 7.

The new address of the Information Section is:— The Department of Scientific and Industrial Research, Rex House, Regent Street, London, S. W. 1.

# SIR C. V. RAMAN AND CRYSTAL PHYSICS*

OPTICAL theory and the physics of crystals are linked together almost inseparably in the history of their development. It is not surprising, therefore, that his love of optics has led Sir C. V. Raman to take an ever-increasing interest in crystal physics, as will be evident from the titles of the papers communicated by him to the Academy during the past decade or two. Many aspects of the subject have received his attention at some time or another. More recently, also, he has considered the fundamental problems of crystal physics from a standpoint which, while it is essentially novel, has proved highly successful in explaining the facts of observation. In these circumstances, it has appeared desirable to include in the present Symposium on Crystal Physics which commemorates his Sixtieth Birthday, a classified list of the papers on the subject which have emerged from his laboratories during the last thirty years. It is of particular interest to trace the development of his ideas and to indicate the fundamental character of the contributions made by him and his school. This will be done in the present survey.

Some of the most beautiful illustrations of optical principles are to be found in the phenomena of crystal optics. Haidinger's and Quetelet's rings in crystalline plates, the iridescence of twinned crystals of potassium chlorate, the optical effects observed with amethystine quartz, the diffraction of light by the laminar boundaries in mica and the haloes observed in the Christiansen experiment with crystal powders are amongst the subjects of this kind investigated during the earliest years of Raman's professoriate by his pupils. The phenomena of conical refraction exhibited by biaxial crystals have also had a special fascination for him. Amongst the discoveries made in this field may be mentioned that of the formation of sharply focussed optical images by plane plates of biaxial crystals. That naphthalene crystals have an extremely large angle of conical refraction and exhibit the effects arising therefrom in a very striking way is another significant contribution. Many studies have also been published of the beautiful phenomena exhibited by the nacreous layer in molluscan shells and the manner in which they are influenced by the size, shape and relative orientation of the platelets of aragonite appearing in its stratifications.

## 2. THE SCATTERING OF LIGHT IN CRYSTALS

In the latter part of 1921, Raman commenced his studies on the diffusion of light in transparent media. These were systematically pursued over a period of years until finally they led to the discovery of the effect

* From the Sir C. V. Raman Sixtieth Birthday Commemoration Volume, *Proc. Ind. Acad. Sci.*, Nov. 1948, Bangalore.

known by his name. The work of this epoch was of significance for crystal physics in several ways. The first major contribution which emerged at an early stage was the discovery of the phenomenon of the *thermal diffusion of light in crystals*. Raman was led to recognize its existence by the fact that the clearest crystals available to him, *viz.*, a polished sphere of quartz and a large transparent block of ice, both exhibited a blue opalescence when traversed by a concentrated beam of sunlight and that the intensities observed were of the right order of magnitude, both relatively and absolutely. Ice, which has a high compressibility, showed the phenomenon more conspicuously than quartz, in spite of the higher refractive index of the latter. The inference suggested by these facts, *viz.*, that the scattering had its origin in the fluctuations of optical density in the crystal due to the thermal agitation was confirmed by heating a quartz block. The intensity of the opalescence was then found to increase, as was to be expected.

Following these early observations, the work with crystals was laid aside and studies with gases and liquids were energetically pursued, as they offered a larger variety of promising material for quantitative work. In February 1928, Raman switched over from sunlight to the monochromatic radiations provided by the mercury arc for his studies on light scattering. When his pocket spectroscope revealed clearly the appearance of radiations of altered frequency in the light scattered by liquids, he instantly realised the importance of looking for a similar phenomenon in the light scattered by crystals as well as by amorphous solids. Observations with a large block of crystalline ice showed sharp displaced lines in approximately the same positions as those observed with distilled water. This fact and its theoretical significance are clearly brought out in the paper announcing the discovery of the effect. The magnitude of the frequency shifts observed with ice showed that the phenomenon was of a different nature from the hermal diffusion of light in crystals discovered in 1921, and was to be accounted for on the same basis as the corresponding effect observed with water, *viz.*, an exchange of energy between the incident light quanta and the vibrations of the structural units of the substance.

### 3. Birefringence and Pleochroism in Crystals

Apart from the discovery of the Raman effect, the studies on the scattering of light in gases and liquids carried on during the years 1921 to 1927 opened up several other pathways of research. They threw a vivid light on the nature of the liquid state, showing clearly that it is far from being a random distribution in space of the molecules composing it. This led Raman to seek a confirmation of his ideas by undertaking with the aid of his collaborators a series of systematic studies on the X-ray diffraction haloes of liquids and glasses. The results obtained in these studies were found to be explicable on the same basis as the facts observed earlier in light-scattering. Of special significance to crystal physics were the deter-

minations of the optical anisotropy of the molecules or ions made possible by measurements of the intensity and depolarisation of light-scattering in fluids. A correlation became evident between the optical anisotropy of molecules in fluids and the birefringence exhibited by the same substances in the crystalline state. This indicated that the birefringence of crystals is determined principally by the optical anisotropy of the molecules or ions and by the manner in which they are orientated with respect to the crystal axes. Thus, from the known optical anisotropy and the observed features of the birefringence, it becomes possible to draw useful conclusions regarding the structure of the crystal. Indications of this kind were found to be particularly useful in cases where the optical anisotropy and the birefringence are both large, *e.g.*, organic crystals of the aromatic class.

The extensive data obtained regarding optical anisotropy also enabled some general conclusions to be drawn regarding the relation between this property and the chemical constitution of the molecule. It emerged that a large optical anisotropy is accompanied by the presence of absorption in the near ultra-violet or visible region of the spectrum. Further, in such cases, the crystals of the substance exhibit a marked pleochroism in which the axis of maximum absorption coincides with that of the largest optical polarisability, though there are some exceptions to this rule.

## 4. Magnetic Anisotropy of Crystals

Many papers on magnetism and magneto-optics figure in the published output of Raman's school. The early studies on light-scattering, remarkably enough, gave an impetus to work in this field. Magnetic birefringence in liquids owes its origin to the fact that while the magnetic field tends to orientate the molecules, their optical anisotropy results in double refraction. Thus, simultaneous studies on magnetic double refraction and on light-scattering in liquids enable the magnetic anisotropy of the molecules or ions to be evaluated and connected with the magnetic anisotropy of the solid crystal of the same substance. The known magnetic behaviour of the crystalline nitrates and carbonates was successfully explained by Raman and Krishnan in this way. The large magnetic anisotropy of the benzene ring deduced by them in the same fashion proved to be a fundamental discovery, since it led to the recognition of the still larger anisotropy of other aromatic molecules and opened the way to the interpretation of the magnetic behaviour of crystals of those substances. Indeed, magnetic studies were shown to be a powerful aid to crystal structure analysis by the early work of Bhagavantam with naphthalene and anthracene. So impressed was Raman by the importance of the method that he initiated studies on magnetic birefringence in many liquids in which it had not been previously observed. This work led to the discovery of the weak negative birefringence exhibited by water, the aliphatic hydrocarbons and other liquids. Crystals of substances exhibiting such negative magnetic birefringence show a relation

between their magnetic and optical behaviour quite different from that of crystals of substances, *e.g.*, the aromatic series, which show a positive magnetic birefringence in the liquid state.

## 5. Raman Effect Studies

Raman's discovery of 1928 opened up a vast new field of activity which was naturally taken up by his collaborators with enthusiasm, and many publications dealing with different aspects of the subject emerged from his laboratory. The effect exhibited by crystals was in the foreground of this activity from the beginning in view of its evident importance for an understanding of the theory of solids; indeed, during the last ten years, work with gases and liquids has been completely laid aside in favour of crystals which present both a challenge and an incentive to investigators in the field. They are a challenge since the difficulties of obtaining satisfactory material and of eliminating spurious effects due to parasitic illumination and instrumental defects are great. They are an incentive, since the sharpness of the Raman lines observed with crystals encourages employment of the most powerful instruments capable of revealing the maximum of detail and yielding data with the precision characteristic of spectroscopy. The major aim of the work in recent years has been that of elucidating the physical problems of the solid state, the substances chosen and the studies undertaken being both determined by this aim. Amongst the topics investigated are the following: the influence of temperature on the sharpness, position and intensity of the lines; the changes in the spectra accompanying thermal transitions in the crystal; the change from the solid to the liquid state; the identification of the modes of vibration active in light-scattering; the influence of crystal symmetry and structure on the spectra, and so forth. We cannot here describe either the techniques employed or the results obtained in these researches. It is necessary, however, to mention an important group of investigations designed to elucidate the fundamental problem of the nature of the vibration spectrum of a crystal. Taking for instance, the case of diamond, its Raman spectrum as ordinarily recorded is a single extremely sharp line with a frequency shift of 1332 $cm.^{-1}$ Obviously, this cannot represent the complete vibration spectrum and there should be other frequencies in it. The task of establishing their existence has been successfully accomplished by the present writer and the results are of very great interest. The results show in a perfectly unambiguous way that the vibration spectrum of diamond consists of a whole series of sharply defined discrete frequencies, of which only the highest is represented by the frequency shift of 1332 $cm.^{-1}$ The remaining frequencies do not appear in the first-order Raman spectrum ordinarily recorded. But with adequate exposures they appear as overtones and combinations in the so-called second-order Raman spectrum. The latter has also been successfully recorded with numerous crystals besides diamond.

### 6. The Thermal Scattering of Light

We return to the phenomenon discovered by Raman in 1921, namely the thermal diffusion of light in crystals. The thermal agitation which gives rise to it may be identified with stationary elastic vibrations of various modes and frequencies determined by the elastic constants and by the size and shape of the crystal. The diffusion itself would arise from the modulation of the optical wave-motion by the elastic vibrations and should therefore exhibit frequency shifts, while its strength would be determined by the photoelastic properties of the crystal. It would evidently not be easy to determine the distribution of intensity in the resulting spectrum unless, following L. Brillouin, we regard the crystal as of infinite extension. Whether this is always permissible is a question.

The frequency shifts to be expected theoretically are small and therefore not easily determined; lack of perfect monochromatism in the incident radiation and any Tyndall scattering present give rise to serious experimental difficulties. The subject is, nevertheless, of great interest and many studies have been published. Particular success has been achieved in the case of diamond which gives large frequency shifts not requiring interferometric aid for their observation. A perfect elimination of the Tyndall scattering is also possible by the use of the resonance radiation of mercury and a mercury vapour filter. An experimental result of great importance which has been established with this technique is that the elastic vibrations in a crystal are wholly incapable of giving rise to an observable diffusion of light, unless their "wave-lengths" are such as to give a regular Brillouin reflection. The behaviour of the elastic vibrations in the crystal is thus in complete contrast with that of the modes of vibration with discrete frequencies which readily record themselves in the second-order Raman spectrum even when they do not appear in the first order.

### 7. The Vibration Spectra of Crystals

A fundamental question in the theory of the solid state is the nature of the vibration spectrum of a crystal. The new approach to the solution of this problem made by Raman is based on the idea that since we are concerned with the vibrations of a mechanical system, we have necessarily to consider its "normal modes". Further, the approach to the problem of finding these modes is necessarily different for the "elastic" vibrations in a continuum, and the "atomic" vibrations in a discrete structure. In the former case the vibrational modes and frequencies are determined by the external boundary conditions, while in the latter case, the time-periodic movements in the units of the structure are analogous to the vibrations of a polyatomic molecule and hence the external boundary conditions are wholly irrelevant. Following up this idea in a straightforward way, Raman derived his fundamental proposition that the structure of a crystal having

$p$ atoms in each of the cells of its structure has $(24p-3)$ normal modes of vibration, and the same number of discrete frequencies of vibration unless this is reduced by reason of symmetry of the crystal and consequent degeneracy of the modes. This is a result of far-reaching importance which explains in a completely quantitative fashion the experimental results mentioned in the preceding two sections. In particular, the experimental fact that the 'elastic vibrations' of a crystal are wholly inactive in light-scattering (except in the case of a Brillouin reflection), while the structural vibrations are active in the second-order if they are not active in the first-order is a clear indication that they are different in their physical nature. The recognition of such a difference is, in fact, the starting point of the new theoretical approach.

## 8. The Structure and Properties of Diamond

Diamond is a substance of extraordinary interest to the physicist engaged in the study of crystals, since it exhibits the characteristic properties of the solid state in an exceptional degree. For this reason the investigation of the physical behaviour of diamond has of recent years formed one of the principal activities of Raman's laboratory and many papers have been published describing the results.

The properties of diamond may be broadly divided into two groups. The first group comprises those that do not exhibit significant variations as between different specimens of diamond. This group includes density, hardness, elasticity, thermal expansion, specific heat, thermal conductivity, refractivity, dispersion, photoelasticity, dielectric constant, magnetic susceptibility, Faraday effect, Raman effect, and infra-red absorption of the second and higher orders. The second group of properties are those which exhibit variations, often of a most striking character, as between different diamonds. Amongst them may be listed infra-red absorption of the first order, absorption spectra in the visible and ultra-violet regions, fluorescence excited by visible and ultra-violet light and by X-rays, phosphorescence, photoconductivity, optical birefringence, intensity and sharpness of the Laue and Bragg X-ray reflections, and dynamic X-ray reflections. If the variations in the properties listed above had been unrelated to each other, the study of the diamond would indeed have been a very perplexing subject. Happily, this is not so, as has been shown by Raman and his collaborators by studies covering all the properties listed above with an extensive collection of material. The results present such striking correlations between the variations of the different properties as to leave no room for doubt that differences are systematic and arise from fundamental differences in crystal structure. This inference receives direct observational support from studies on the crystal morphology of diamond. The situation may be summed up broadly by the statement that the electronic structure of diamond may possess either tetrahedral or octahedral symmetry. Assuming each atom

of carbon to possess only tetrahedral symmetry, geometric consideration indicate that there must be two sub-species (positive and negative, respectively) of the tetrahedral type and two sub-species of the octahedral type. The recognition of the existence of these four species of the diamond structure, appearing separately or together in any actual specimen of diamond enables the varied behaviours actually met with to be satisfactorily described and interpreted.

### 9. Luminescence and Absorption Spectra

The luminescence of diamond, a long-known but neglected phenomenon, has been studied with great thoroughness by Raman and his collaborators with results of exceptional interest. Two distinct types of luminescence based on different electronic transitions are observed, and the same electronic transitions can also appear in absorption. They may be coupled with vibrational transitions in the crystal lattice and as the result, the principal emission or absorption in each case appears accompanied by subsidiary radiations of less and greater frequency respectively. The emission and absorption spectra exhibit mirror-image symmetry with respect to each other about the electronic frequency. The lattice frequencies deduced from the spectra agree with those given by the new crystal dynamics, which was in fact first developed to explain the effects observed in the luminescence spectrum of diamond.

The coupling of electronic with vibrational transitions so clearly manifested in the case of diamond is a general feature in the luminescence spectra of crystals. As a consequence, Raman effect studies are of great assistance in interpreting such spectra. As an illustration, one may cite the case of the fluorescence and absorption of the uranyl salts, as also the cases of alumina and of topaz investigated by the present writer. The lattice frequencies of magnesium oxide calculated on the basis of theory fit very well with those deduced from its luminescence spectra resulting from the presence of a trace of chromic oxide as impurity.

### 10. Infra-Red Absorption Spectra

All diamonds without exception exhibit an infra-red absorption spectrum of the second order, while the diamonds of the tetrahedral class exhibit also a first order absorption. These spectra have been thoroughly investigated and are explicable in all their details on the basis of the new lattice dynamics. Particularly interesting is the fact that the two weakest second-order Raman lines (2176 cm.$^{-1}$ and 2015 cm.$^{-1}$) are represented in the second-order infra-red absorption by its two most conspicuous peaks, as is to be theoretically expected. A feature which manifests itself conspicuously in the first order infra-red absorption by diamond is that all the nine fundamental modes of vibration of the lattice are active, though in different degrees, and not merely the so-called principal oscillation having the highest frequency.

The absorption curves exhibit distinct peaks corresponding to the different modes, but their resolution is far from perfect. These features are explicable as due to the coupling of the different modes with each other due to anharmonicity. Such coupling would necessarily manifest itself even more strongly in the case of strongly infra-red active crystals and offers a basis for an explanation of the features exhibited by their absorption spectra.

## 11. Thermo-Optic Properties of Crystals

Studies of the effect of temperature on the optical properties of diamond have pointed the way to the development of a successful quantitative theory of the thermo-optic behaviour of crystals. The refractive index of diamond increases instead of diminishing with rise of temperature, this increase becoming more rapid as we approach the violet end of the spectrum. In consequence, the dispersion of diamond is enhanced by rise of temperature even more rapidly than its refractive index. The sharply defined electronic absorption lines in the visible and ultra-violet region exhibited by diamond at low temperatures are observed to drift towards lower frequencies when the temperature is raised. It may therefore be reasonably assumed that the characteristic frequency in the extreme ultra-violet principally responsible for the dispersion also shifts downwards with rise of temperature. Such a shift would result in an increase of dispersion and refraction which would only be partially be set off by the diminution caused by the thermal expansion. Not only does this idea work successfully in the case of diamond, but it is found to be remarkably successful also in explaining the facts observed with numerous other crystals, both those which are isotropic, *e.g.*, the alkali halides and those which are birefringent, *viz.*, quartz, calcite and aragonite. The basis of the theory, namely the diminution of the characteristic frequencies in the remote ultra-violet with temperature, also finds direct observational support.

## 12. Photoelastic Properties of Crystals

One of the earliest attempts to develop a quantitative theory of the photoelastic behaviour of crystals was that made at Raman's suggestion in 1927 by Kedareswar Banerji. The subject has acquired considerable importance in recent years by reason of its relationship to other phenomena, *viz.*, the optical effects arising from mechanical oscillations in a crystal and the thermal diffusion of light. The theory of the diffraction of light in ultrasonic fields originally put forward by Raman and Nath to explain the effects observed in liquids, applies *mutatis mutandis* to the case of a crystal when the relevant piezo-optic constants are introduced in the formulæ. The recent determination of the piezo-optic constants of diamond was, in fact, made with a view to work out the consequences of Brillouin's theory of the thermal scattering of light in it. Measurements with other crystals will no doubt prove of great value in this field of research.

## 13. Magneto-Optic Behaviour of Crystals

One of the many remarkable properties of diamond is the feebleness of the Faraday effect observed with it when considered in relation to its high dispersive power. The rotation of the plane of polarisation of light produced by a magnetic field is only one-fourth of that to be expected on the basis of the well-known Becquerel formula. The measurements which revealed this fact were made possible by the plates of diamond free from birefringence included in Raman's collection. The explanation for the low value is evidently to be found in the covalent character of the bonding of the atoms of carbon in the crystal with each other. The case of diamond thus clearly indicates that measurement of the "magneto-optic anomaly" exhibited by a crystal offers a method of ascertaining the nature of the electronic states in its atoms or ions. Studies with other crystals have since been pursued with this aim in view.

## 14. Elastic Properties of Crystals

Methods based on the use of piezo-electrically excited oscillations have opened out new possibilities for the accurate determination of the elastic constants of crystals. The recent work of Bhagavantam and his collaborators at Waltair may be specially mentioned in this connection. The problem naturally arises of seeking to connect these experimentally observed constants with the known crystal structure and if possible to derive them theoretically on the basis of that structure. The first step in any such attempt is evidently the evaluation of the interatomic forces arising from the displacements of the atoms from their positions of equilibrium. One way of finding these forces is to connect them with the frequencies of atomic vibration made accessible to observation by the Raman effect and from these frequencies as actually observed to evaluate the forces. A rigorous method of accomplishing this has been worked out in the case of various crystals. Difficulties arise in the next step, namely that of evaluating the elastic constants from the interatomic forces, but we shall not discuss them here.

## 15. The Thermal Properties of Crystals

The evaluation of the specific heat of a crystal requires a knowledge of its vibration spectrum. The proposition that this spectrum consists of $(24p-3)$ discrete frequencies places the theory of specific heats on a very simple and intelligible basis. Further, when these frequencies are accessible to direct spectroscopic observation, a comparison between the actual and calculated specific heats becomes possible. It may be remarked that the three excluded degrees of freedom represent the spectrum of elastic vibrations in the crystal. These appear at the very lowest end of the frequency range. Hence in most cases it is a sufficient approximation to regard them as fully excited at the temperature of observation and make the necessary addition to the specific

heat; a more exact calculation may, however, be necessary if $p$ be small and if the temperature is very low. Calculations of the specific heat made in this manner for crystals for which the necessary spectroscopic data are available, *e.g.*, diamond, show a satisfactory agreement with the facts.

Another property of a crystal which is intimately related to its vibration spectrum is its thermal expansion. Data regarding the thermal expansion coefficient of crystals are rather meagre. For example, no data were available for diamond above the room temperature. The present writer has developed a new precision method of measuring the coefficient of thermal expansion of crystals and applied it to the case of diamond which, as is well known, has a very small dilatation. Attempts to evaluate the thermal expansion of diamond and of other crystals theoretically on the basis of the spectroscopic data as in the case of their specific heats have given very encouraging results.

## 16. X-Ray Studies

The striking developments in X-ray physics which followed in the wake of Laue's great discovery of 1912 were already accomplished facts when Raman commenced his professoriate. Hence, neither X-ray spectroscopy nor crystal structure analysis was ever adopted by him as a part of his regular research programme. Nevertheless, these subjects have interested him greatly, as will be evident from the numerous X-ray studies published from time to time from his laboratory.

In April 1940, Raman and Nilakantan published in an article in *Current Science* under the title "A new X-ray effect", some strongly exposed Laue photographs obtained with an octahedral cleavage plate of diamond and the X-radiation from a copper target. These photographs showed some remarkable features which they explained as arising from dynamic reflections of the incident X-radiation by the (111) planes of the crystal. They gave reasons for believing that the crystal planes giving these reflections were set in vibration with the same frequency as that observed in the Raman spectrum of diamond and that the excitation was quantum-mechanical as in the case of the Raman effect. The reality of the effect is indisputable and on the basis of the explanation indicated, it is clearly of fundamental importance. Raman and Nilakantan subsequently published further experimental results which confirmed the correctness of the explanation given by them. We shall not here enter further into the subject except to remark that the explanation of this X-ray effect stands in the closest relation to the problem of the nature of the vibration spectrum of a crystal. The same question also enters fundamentally into the theory of the diffraction of X-rays by crystals and of the influence of temperature on the same.

R. S. Krishnan.

Editor: M. Sreenivasaya, B.A., F.I.I.Sc., F.A.Sc.
Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore.